Vol. 38, No. 4 December, 1912 Whole No. 144

United States Naval Institute Proceedings

PUBLISHED QUARTERLY
EDITED BY RALPH EARLE

U. S. NAVAL INSTITUTE
ANNAPOLIS — MARYLAND

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The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

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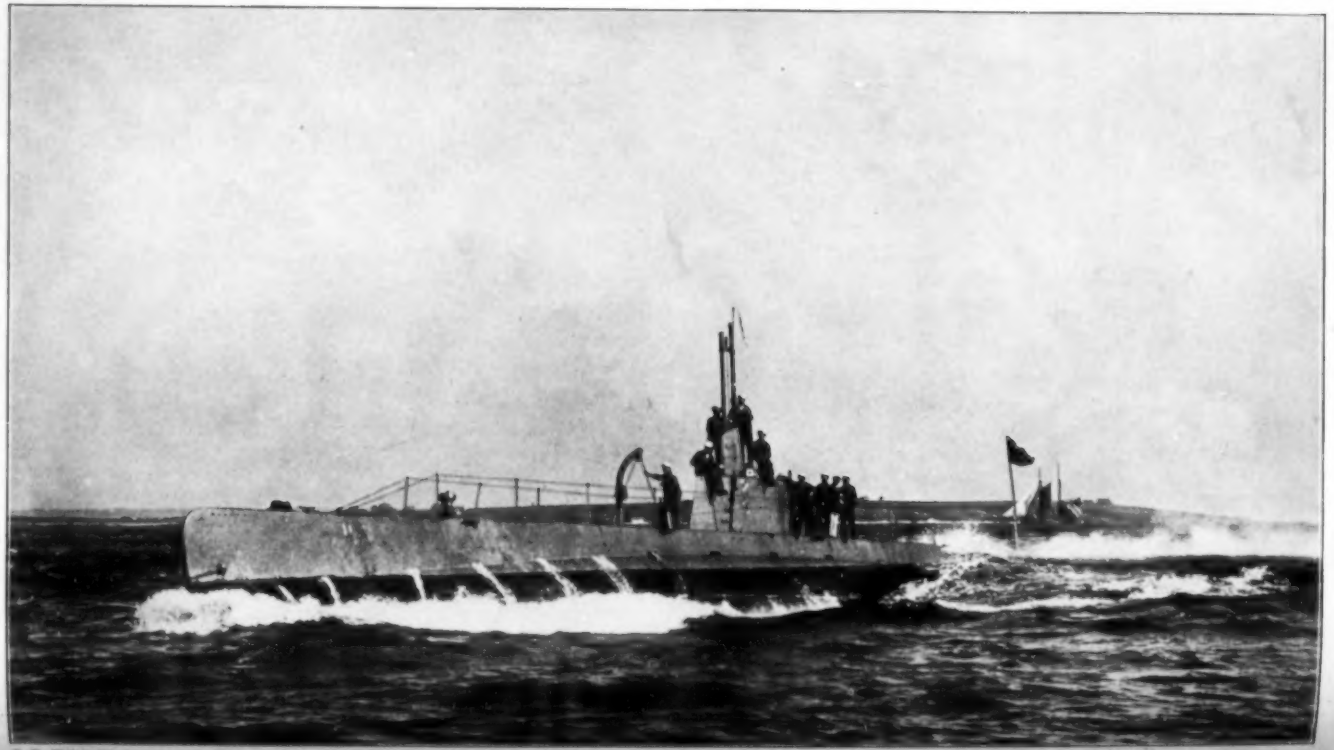

D. W. Fishman

U. S. S. O-2, MAKING A SURFACE RUN

UNITED STATES NAVAL INSTITUTE PROCEEDINGS.

Vol. 38, No. 4. DECEMBER, 1912. Whole No. 144.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

MILITARY VALUE AND TACTICS OF MODERN SUBMARINES.

By LIEUTENANT C. W. NIMITZ, U. S. Navy.

VALUE AND TACTICS OF THE MODERN SUBMARINE.

The military value of any vessel designed for war purposes depends largely on the following factors:

A. *Communication,* or the ability to transmit and receive information or battle orders either before or during contact with an enemy.

B. *Mobility,* or the ability to move quickly from place to place in all conditions of weather. Under this factor may be included the habitability of the vessel, or its ability to maintain a crew in normal health and fighting power.

C. *Invulnerability,* or the ability to resist attack.

D. *Offensive strength,* or the ability to deal a telling blow when in contact with the enemy.

In estimating the military value of the submarine or submersible, as compared with the modern battleship, we find that each has a distinct and separate value. The battleship on account of its mobility as defined above can operate where submarines or submersibles of the present day cannot go, due to their lack of mobility. On the other hand, leaving out the factor of mobility, which for submarine craft of the future will advance more rapidly than for surface craft, we find that submarine craft rank equally well, if not better than surface craft.

COMMUNICATION.

Submarine craft on the surface within sight of each other have the same ability as other surface craft to communicate freely, using for this purpose the various systems of day and night signalling used in surface craft. For long distance signalling the submarine or submersible has a radio outfit capable of operating at distances up to fifty (50) miles. As the range of the radio outfit depends on the height of the aerial, the larger submarine boats can easily obtain a greater range by using higher masts. The present practice consists in carrying the portable aerial on two masts which fold down on the deck just before submerging. The sending and receiving apparatus is permanently installed in

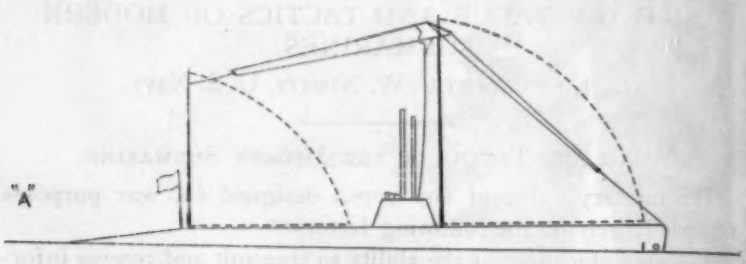


FIG. 1.

the forward end of the submarine, as far as possible from the noise and vibration of the propelling machinery. Sketch "A."

The sketch shows the arrangement of the masts and aerial as rigged on submarines in our service. In this rig the aerial is about thirty (30) feet above the deck, and can be taken down ready for submergence in five (5) minutes. The value of the radio outfit in time of war is greatly increased by the proper use of fast scouting vessels also equipped with radio.

For communicating below the surface, submarine craft use bell signals, the bell being sounded by a pneumatically operated striker from inside the boat. Under the most favorable circumstances, with all machinery stopped, boats have exchanged signals at distances up to eight (8) miles. Under the most unfavorable conditions, with boats running away from each other on opposite courses, signals have been exchanged at distances up to one-half of one mile. Numerous experiments have been made to establish

reliable radio communication below the surface, but, up to the present, without success.

As submarine craft on "station" or prior to sighting an enemy's smoke will habitually remain on the surface, and as submerged communication by means of a bell or sounding apparatus can be intercepted by friend or foe alike, there is no practical value to this method of communication, except to avoid collision in training exercises in time of peace. A group of submarines operating submerged and using bell signals in the presence of an enemy can easily be located along certain lines of bearing. If then, the enemy is equipped with receiving apparatus as most modern ships are, he has only to run away to avoid torpedo attack. The submerged speed of a submarine or submersible will never equal or exceed the surface speed of a battleship unless that battleship is disabled, therefore a submarine commanding officer should be very loath to sound his bell for safety's sake, and thus lose the chance of coming within torpedo range.

MOBILITY.

The development of the Diesel internal combustion engine has added greatly to the mobility and safety of the submarine. Among the many advantages of the Diesel engine over the gasoline engine are the following:

(a) Economy in cost and consumption of fuel.
(b) Increased cruising radius for a given tank capacity.
(c) Increased reliability of performance.
(d) Greater safety in handling of fuel.
(e) Absence in engine room of noxious fumes and gases.

The fuel consumption per horse-power hour varies slightly with the size and speed of the engine, being lowest for large and slow speed engines, and a little higher for small and high speed engines. A fair average fuel consumption is .5 lbs. per brake horse-power per hour. The average specific gravity of ordinary fuel oil is .89, equivalent to 7.4 lbs. per gallon. The fuel consumption therefore amounts to .54 of a pint per horse-power hour. The average price of such oil is 3 cents per gallon, making an average fuel cost of .2 cents per brake horse-power. In a gasoline engine of about the same power, the average consumption is one pint per horse-power hour. With gasoline at an average cost of

12 cents per gallon, the cost of the gasoline engine is 1.5 cents per brake horse-power hour, or about 7½ times the cost of the fuel oil engine.

The use of the internal combustion fuel oil engine has practically doubled the cruising radius of submarines and has made it possible for these craft to have about the same cruising radius as a modern battleship. The surface speed of the submarine is naturally not as high as that of a battleship, due to the spindle form of hull of the former, that being a poor form for surface speed, but an excellent form for submerged speed and strength. In order then to attain the surface speed necessary to permit a group of submarines to cruise with a battle fleet, it will be necessary to adopt a "ship shape" form of hull, and thus sacrifice a small amount of submerged speed and strength. Whereas contractors guarantee a strength capable of withstanding a pressure at 200 feet in a submarine of the spindle form, they will only guarantee 150 feet submergence, with safety, with the "ship-shape" form of hull.

The total absence of an ignition system and all of its attendant troubles tends to greater reliability of motive power. With the two-cycle reversible type of heavy oil engine, the number of moving parts is reduced to a minimum, and the engine is very compact and easily accessible for overhauling.

The use of heavy oil instead of gasoline in submarine craft has removed the greatest source of danger. The only accidents worthy of mention in our service have been due to gasoline fires in the torpedo compartment, or in the engine room. The moral effect on the crew caused by the removal of the gasoline danger cannot be overestimated.

In the use of gasoline engines, there is always an odor of raw gasoline or of burned gasoline in the engine room. In fine smooth weather, it has been possible to keep the engine room fairly well ventilated, but in rough weather the hatches must be battened down, thus making it very difficult to rid the boat of fumes. Numerous cases of "gasoline jags" have occurred both at sea and in port. The victim on watch in the engine room inhales the raw gasoline fumes which come from the engines or from the fuel pumps, which are very difficult to keep tightly packed. He gradually loses his senses, and just before lapsing into total unconsciousness, becomes very violent. If he is not

immediately removed from the engine room he may fall into the moving machinery. The aid of several men is sometimes necessary to control the struggles of the "jag," and thus prevent self-injury before he loses consciousness. The after-effects of such a case is usually a violent nausea and headache, and an extreme distrust of the gasoline engine. The use of heavy oil fuel has removed the source of danger from submarines and has made it possible to keep the engine room air good and clean in all conditions of weather.

Before leaving the question of mobility, it will be well to point out that submarines and submersibles have about the same qualities as surface craft as regards handling under various conditions, and as regards towing. Submarines may be towed with their crews aboard at speeds up to twelve (12) knots, the reliability of the operation depending only on the reliability of the towing apparatus. They may be submerged with absolute safety in all conditions of weather. In heavy weather they may be sealed up, that is, all hatches battened down, and navigated with absolute safety from the conning tower. Under such conditions, the air necessary for the engines and the crew is drawn into the boat through a ventilator controlled from inside the boat.

INVULNERABILITY.

In comparing the invulnerability of the submarine with that of the battleship, we find that where the battleship has armor whose resisting qualities are always more or less doubtful, the submarine has complete invisibility until within torpedo range, and after arrival within range has only two very small periscopes momentarily exposed over a hull about twelve (12) feet under the surface. The difficulties of hitting such a small moving target are great, and it must be kept in mind that the submarine at this stage of the action has already fired her torpedoes and inflicted her damage. There is no accurate information at hand to show the effect of firing a large shell at a hull submerged about ten (10) or twelve (12) feet, but recent experiments in England show that a submarine anchored with the hull about ten (10) feet below the surface can be sunk by heavy gun fire at comparatively short ranges.

OFFENSIVE STRENGTH.

The offensive strength of a submarine lies in her ability to maneuver submerged to within easy range of a surface vessel, and then to fire torpedoes without being subjected to a dangerous fire from her enemy. The surface vessel has no defense against the submarine, except her speed in running away, and in doing this she may be running directly into the danger zone of another group of attacking submarines.

The steady development of the torpedo together with the gradual improvement in the size, motive power, and speed of submarine craft of the near future will result in a most dangerous offensive weapon, and one which will have a large part in deciding fleet actions. Even at this present day it is impossible for an enemy to blockade a port protected by submarines, and decidedly dangerous to even attempt operations anywhere along the coast where it is known that submarines are employed in the coast defense.

SUBMARINES AND SUBMERSIBLES.

The hull of the submarine is generally of the spindle form, the cross sections being circles. This form of hull gives greater strength for equal weight of scantling, and is the form best adapted for submerged speed. With this form of hull, however, the maximum surface speed is reached when running at about fifteen (15) knots. The reserve buoyancy of the submarine when light is about twenty (20) per cent of the total displacement. The submersible has a "ship-shaped" form of hull, that is, its hull has more nearly the form of a surface torpedo boat. The surface speed of the submersible can easily be made high enough to enable it to accompany a sea-keeping fleet of battleships, whereas its submerged speed will fall about twenty (20) per cent below a submarine of equal size. The submersible having a reserve buoyancy of about sixty (60) per cent is apparently a better sea boat than the submarine. The submersible with its "ship shape" hull cannot be built with the same strength as the submarine, and where submarines are built to stand a submergence of two hundred (200) feet with safety, the submersible is guaranteed only to depths of one hundred and fifty (150) feet. It would seem then in order to obtain groups of sea-keeping submarine craft, it will be necessary to adopt the "submersible" type.

The relative advantages and disadvantages of the two types are given as follows:

SUBMARINE.

ADVANTAGES.

(a) Greater submerged speed and strength.
(b) More torpedo tubes in bow due to blunt form.

DISADVANTAGES.

(c) Less habitability due to reduced buoyancy and sea-keeping qualities.
(d) Lower surface speed due to poor form of hull.

SUBMERSIBLE.

ADVANTAGES.

(e) Greater surface speed.
(f) Greater habitability and sea-keeping qualities.

DISADVANTAGES.

(g) Reduced strength and submerged speed.
(h) Fewer torpedo tubes in the bow due to fineness of form.

As regards control on surface and submerged, the two types are practically the same. The submerged radius of action of the submersible is slightly less than that of the submarine, while its radius of action on the surface is slightly greater.

MODERN TYPES OF SUBMARINES AND SUBMERSIBLES.

The accompanying plate, Figs. 2 to 8, taken from *Engineering*, by permission, shows a modern submarine of the following approximate dimensions:

Length	150 feet.
Beam	15 ft. 6 in.
Displacement (surface)	300 tons.
Displacement (submerged)	520 tons.
Buoyancy percentage of submerged displacement	25 per cent.
Buoyancy percentage of surface displacement	33 per cent.
Surface speed	14½ knots.
Surface cruising radius	4500 nautical miles.
Submerged speed	10½ knots.

Submerged radius	120 nautical miles.
Safe depth of submergence	200 feet.
Armament	4 torpedo tubes and 8 torpedoes.

Figs. 9 to 14 on the accompanying plate show a modern submersible of the following approximate dimensions:

Length	212 feet.
Beam	21 feet.
Surface draft	12 feet.
Surface displacement	650 tons.
Submerged displacement	950 tons.
Buoyancy percentage of submerged displacement	31½ per cent.
Buoyancy percentage of surface displacement	46 per cent.
Armament	8 torpedo tubes.
Surface speed	17 knots.
Submerged speed	11 knots.
Surface radius of action	5000 nautical miles.
Submerged radius of action	140 nautical miles.
Safe depth of submergence	150 feet.

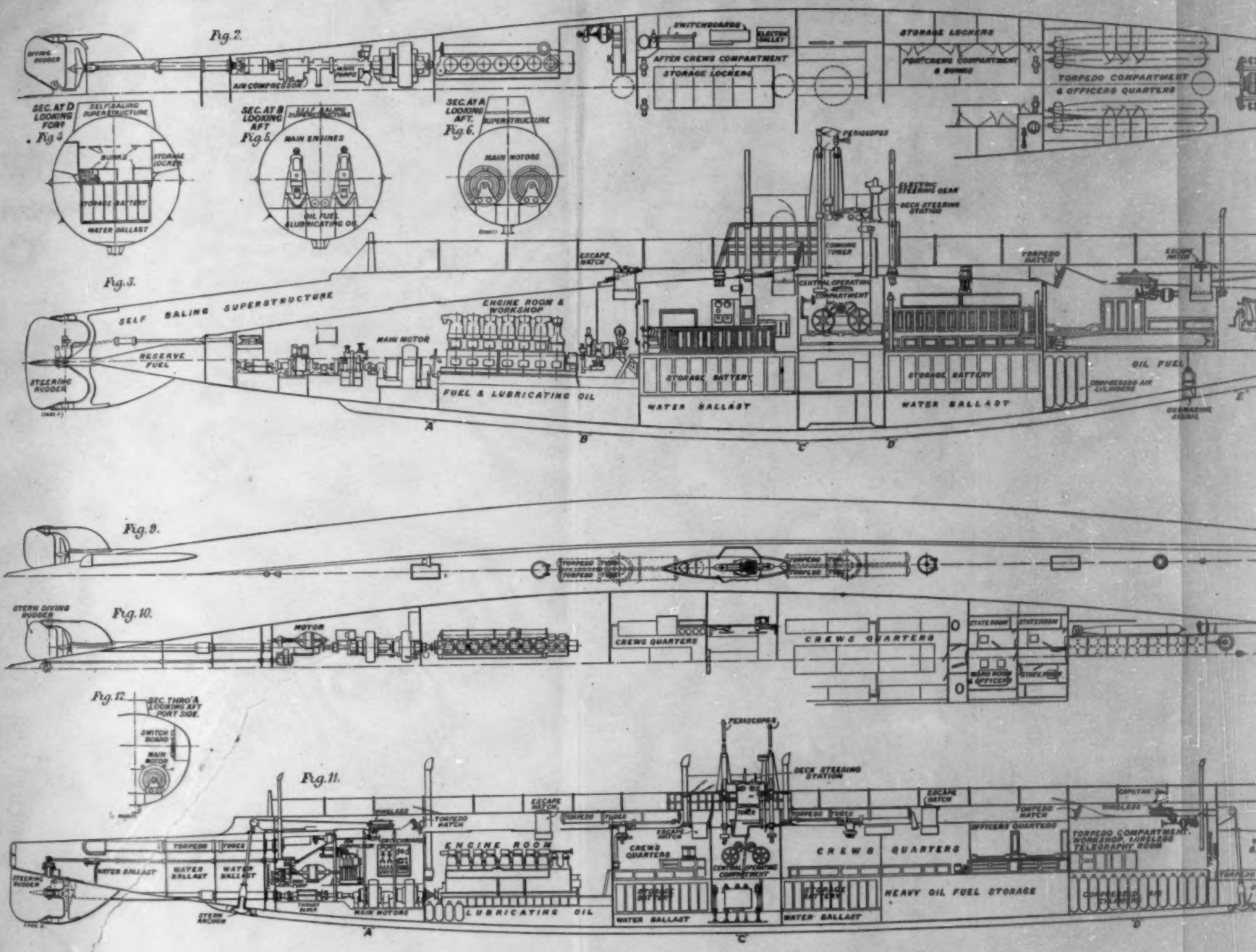
The submersible herewith is similar in many details to those built in France from the designs of M. Laubeuf, and in Italy from the designs of Major Laurenti.

TACTICS OF SUBMARINE CRAFT.

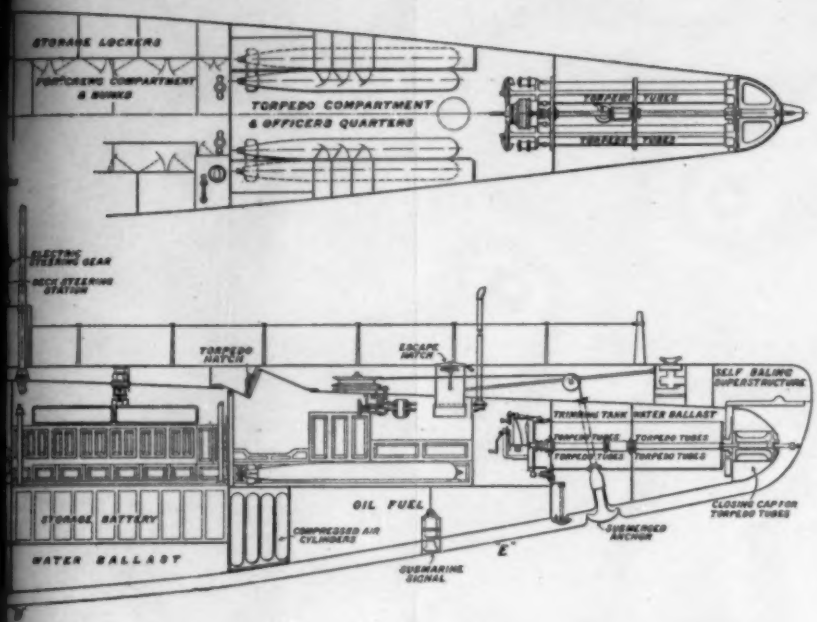
Definitions are here given to the terms "light" condition, "awash" condition, and "submerged" condition.

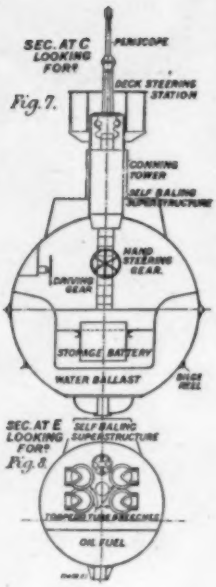
A submarine in the "light" condition has all of its water ballast tanks empty, and has its cruising bridge rigged. With the present form of cruising bridges, it is estimated that at least twenty minutes will be required to trim down to the submerged condition. In the new boats, however, folding bridges are under consideration which will require much less time to strike down.

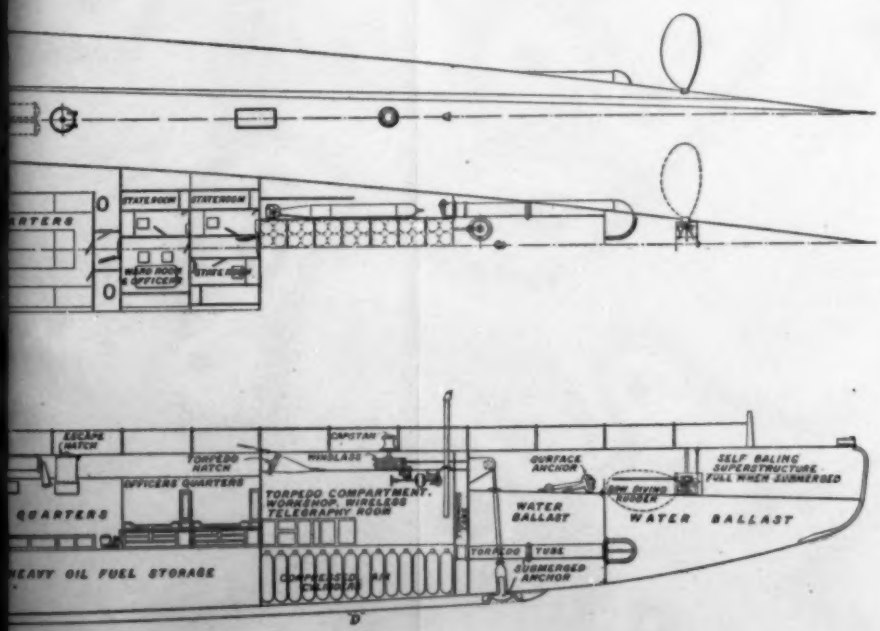
A submarine in the "awash" condition has only those water ballast tanks empty which are habitually kept full when running submerged. The fore and aft trimming tanks and two smaller tanks, called the auxiliary and adjusting tanks, are filled with just enough ballast so that when the main ballast tanks are filled, the boat will be immediately ready for running submerged without further adjustment of ballast. The quantity of water in the trimming tanks and in the auxiliary and adjusting tanks, in the

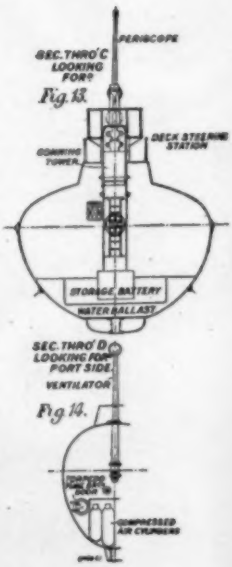


TWO TYPES OF MODERN SUBMARINE BOATS.


STORAGE LOCKERS
FORE CREWS COMPARTMENT & BUNKS
TORPEDO COMPARTMENT & OFFICERS QUARTERS
TORPEDO TUBES
TORPEDO TUBES
ELECTRIC STEERING GEAR
DECK STEERING STATION
TORPEDO HATCH
ESCAPE HATCH
SELF BALING SUPERSTRUCTURE
TRIMMING TANK
WATER BALLAST
TORPEDO TUBES
TORPEDO TUBES
TORPEDO TUBES
TORPEDO TUBES
STORAGE BATTERY
OIL FUEL
COMPRESSED AIR CYLINDERS
CLOSING CAP FOR TORPEDO TUBES
SUBMERGED ANCHOR
WATER BALLAST
SUBMARINE SIGNAL
E


SEC. AT C LOOKING FOR?
Fig. 7.
PERISCOPE
DECK STEERING STATION
CONNING TOWER
SELF BALING SUPERSTRUCTURE
HAND STEERING GEAR
DRIVING GEAR
STORAGE BATTERY
WATER BALLAST
BILGE WELL
SEC. AT E LOOKING FOR?
Fig. 8.
SELF BALING SUPERSTRUCTURE
TORPEDO TUBE BREECHES
OIL FUEL


STATEROOM
STATEROOM
WARD ROOM & OFFICERS
STEERING
ESCAPE HATCH
CAPSTAN
TORPEDO HATCH
WINDLASS
SURFACE ANCHOR
SELF BALING SUPERSTRUCTURE, FULL WHEN SUBMERGED
OFFICERS QUARTERS
TORPEDO COMPARTMENT, WORKSHOP, WIRELESS TELEGRAPHY ROOM
WATER BALLAST
ARM DIVING RUDDER
WATER BALLAST
TORPEDO TUBE
SUBMERGED ANCHOR
HEAVY OIL FUEL STORAGE
COMPRESSED AIR
D


SEC. THRO' C LOOKING FOR?
Fig. 13.
PERISCOPE
CONNING TOWER
DECK STEERING STATION
STORAGE BATTERY
WATER BALLAST
SEC. THRO' D LOOKING FOR PORT SIDE.
VENTILATOR
Fig. 14.
COMPRESSED AIR CYLINDERS

BOATS.

"awash" condition, is so small in comparison with the total ballast, that for all practicable purposes the submarine has the same stability and safety as when running "light." In the "awash" condition a small section of bridge may be kept up for the lookout, and the conning tower hatch may be kept open and the radio rigged. It is estimated that five minutes will be required to trim down to the "submerged" condition from the "awash" condition. If any fuel is used while in the "awash" condition, the additional necessary weight can easily be computed and added to the trimming tanks. In time of war all submarines on station should habitually remain in the "awash" condition.

A submarine in the "submerged" condition has its ballast tanks and other tanks so filled that there still remains a small reserve of buoyancy (0 to 800 lbs.) and is all ready to run submerged.

TACTICS.

For the purpose of tactics submarines may be divided according to their capabilities into three classes, viz., harbor defense, coast defense, and sea-keeping offensive submarines.

Taking into consideration the capabilities of the harbor defense boats, this class should be sent to the Philippines, where the areas of defense around such strategical points as the entrance to Manila or Subig bays are comparatively small. Four of this class are now in commission in Manila Bay, two are in commission on the West Coast, and four are in reserve in Charleston, S. C. The five new boats of this class are admirably adapted for the defense of either end of the Panama Canal. For the protection of the harbors on the East and West coasts of the United States, there should be a group of five submarines and one suitable tender stationed at each of the harbors and places which are considered worthy of protection for strategical reasons. There are now only twenty-four submarines available for this purpose, and it is estimated that for the proper protection for the East and West coasts of the United States, there should be a total of fifty-five submarines on the East Coast, and a total of forty-five submarines on the West Coast. These submarines should be based on mobile tenders located as follows, one group of five boats operating from each base:

EAST COAST.

Bar Harbor, Me.
Portsmouth, N. H.
Gloucester, Mass.
Provincetown, Mass.
Point Judith Breakwater.
New York, N. Y.
Delaware Breakwater.
Norfolk, Va.
Charleston, S. C.
Key West, Fla.
Pensacola, Fla.

WEST COAST.

Port Townsend, Wash., two groups.
Columbia River, Ore., two groups.
San Francisco, Cal., two groups.
Santa Barbara, Cal., one group.
San Pedro, Cal., one group.
San Diego, Cal., one group.

As stated before, there are now twenty-four (24) submarines built or building, and a total of one hundred (100) are required to form a complete chain of defense about the great harbors and cities of our country. No mention has been made of the submarines for the defense of our over-sea possessions, such as Guam, Hawaiian Islands, etc., but it is believed that a mobile tender with a group of five (5) submarines will most effectually prevent the operations of a hostile fleet in these waters.

The tactics of a group of harbor defense submarines are extremely simple. Their limited submerged radius and speed will not enable them to operate far from the entrance of the harbor which they are protecting. The lack of reliable under-water communication makes it impossible to change plans of action once the group is submerged, without giving the enemy a clue as to the submarine's whereabouts. The argument might here be made that the enemy must know that certain harbors have submarines for their protection, and that a prudent enemy would not venture to attack such a place, and that the submarines would thus accomplish their object without further effort. That might be true enough, but there are always enough commanders of the "damn

the torpedoes and submarines " type who would take the risk, and it is for such kind that arrangements must be made. Any form of under-water signalling device at use in the present time can be accurately located in direction by the enemy. This apparatus for locating the direction of submarine signals is installed on practically every modern ship. So, for this reason alone, must the detailed plans for a group of harbor defense submarines be made explicit enough to cover every phase of an attack by a determined enemy.

Each boat of a group must be assigned a certain area outside of the harbor, which will be its zone of defense, these zones to be so selected that all approaches to the harbor are protected, and to be at such a distance from the point of defense that the enemy will never come within gun range. Most of our harbors lend themselves naturally to such a method of defense by the form of the channels leading to them, or by the presence of islands in the vicinity. A harbor defense group, having received warning from scouts or shore stations, of the movements of the enemy off the coast, immediately proceeds to the entrance, leaving the tenders inside the harbors. Submarines anchor in the " awash " condition, radio up, in the centers of their zones and keep a lookout for the enemy. By sub-dividing the total area outside each harbor into numerous small squares and using short code words to designate squares and directions, our scouts in touch with the enemy can easily keep the waiting group of submarines informed as to the enemy's movements. This method was successfully used last summer in the combined maneuvers off Block Island, and had the waiting submarines been equipped with radio, the results would have been even better than they were. As it happened last year, the submarines were dependent upon a fast scout to come from an inner scouting line and give information by signal or megaphone to the submarines in their zones. The waiting submarines having ascertained definitely, or in all probability that the enemy will pass close to their harbor, immediately get up their anchors, lay down their radio masts and submerge as soon as smoke appears on the horizon. With a moderate amount of their periscopes exposed a submarine can easily see a large ship in clear weather for a distance of seven or eight miles. During maneuvers in Long Island Sound with the U. S. S. *Dixie,* her masts and smoke were easily seen from the *Snapper's* (C-5) periscopes at a distance of nine

miles, with about four feet of periscopes exposed. The submerged group, each boat in its zone, remain stationary until the movements of the hostile fleet are definitely ascertained. By the arrangement of the zones, the enemy must pass close to one submarine; the other boats must then move over towards the enemy at such speeds and with just enough periscope exposure to enable them to get within torpedo range without detection. Once within torpedo range they keep their periscopes exposed and make all speed possible to get within easy torpedo range to fire their torpedoes at that part of the enemy's formation previously assigned to them. In this last maneuver they must act regardless of their other boats, and must take the risk of collision. On this final charge, the submarine bells may be rung continuously to assist the submarines to keep clear of each other. Having fired their torpedoes, the boats submerge totally, and reload their tubes if they have spare torpedoes. During the period of reloading they may run at such depths as would enable them to pass under the enemy's vessel, or if the depth of water permits, they can rest on the bottom until the reload is finished, when they should return to the surface to inflict such further attack as is possible. A submarine having exhausted her supply of torpedoes has still a most formidable weapon in her ram. That this weapon is most efficacious and without danger to the crew of the boat was proven in the fall of 1910, when the C-4, at a comparatively low submerged speed rammed the tender *Castine*, causing her to settle immediately. There can be no doubt that the torpedo properly adjusted, and used with the short ranges possible in harbor defense, will be effective. There are even instances on record where torpedoes with exercise heads have seriously damaged the hulls of vessels by the force of impact.

The harbor defense group having exhausted its means of offense should return to the tender, submerged, if necessary, or under cover of darkness, to replenish torpedoes and storage batteries.

For the night defense of the harbor, submarines remain on the surface in their zones, being used in this manner most effectively as surface torpedo boats. The tactics on the surface as torpedo boats are similar to the tactics employed in surface torpedo craft, and as they are well known to the service, they need not be described here.

COAST DEFENSE SUBMARINES.

The distinction between a coast defense and a harbor defense submarine lies in the greater submerged and surface endurance, the greater submerged and surface speed, and the better habitability conditions of the coast defense boat. Considering the most inferior of our present coast defense submarines, we find that they have been making cruises up and down the coast as far south as Norfolk, Va., and as far north as Gloucester, Mass.

Our government on account of the general topography of its coast should not build any more strictly "harbor defense" boats. A "coast defense" group will accomplish with greater effect the same duties that are now accomplished by the harbor defense group. Countries in Europe are so close together that smaller submarine craft and more of them are of greater military value than fewer and larger submarines. Our general policy of submarine construction should not be too greatly influenced by the building programs of European nations. Ours is a separate and distinct problem.

In considering the tactics of a group of "coast defense" boats, it is assumed that information has been received from reliable sources, scouts or shore stations, that the enemy's fleet is approaching our coast with the evident intention of seizing a base or of landing a force. The group proceeds at its highest reliable surface speed in column in the "awash" condition, with radio up, to intercept or to come in contact with the enemy. The submarine with its low hull can easily distinguish the masts and other characteristics of a vessel when the submarine cannot be seen at all. On sighting the smoke or masts of the hostile fleet, and having approximately determined his course, the entire group immediately submerges, after rigging down the radio, and proceeds submerged at about one-half mile distances in the general direction of the enemy at such speeds and under such general directions as may have been previously issued by the group commander. The submarine group, submerged at one-half mile distances can easily keep clear of each other. They must then maneuver to keep a position on either bow of the enemy's column in order to insure their getting within torpedo range before being sighted. This approach must be made totally submerged, with an occasional "porpoise" or periscope exposure of short duration.

When within torpedo range periscopes should be exposed enough to keep an easy bearing on the enemy, and the speed increased as much as possible to arrive within "easy" torpedo range (between 500 and 1000 yards) before the enemy has time for a concerted maneuver. Each submarine fires its torpedoes at the parts of the formation previously agreed upon, totally submerges, reloads as soon as possible, and returns to the attack. The following sketch to scale shows the most favorable condition under which a group

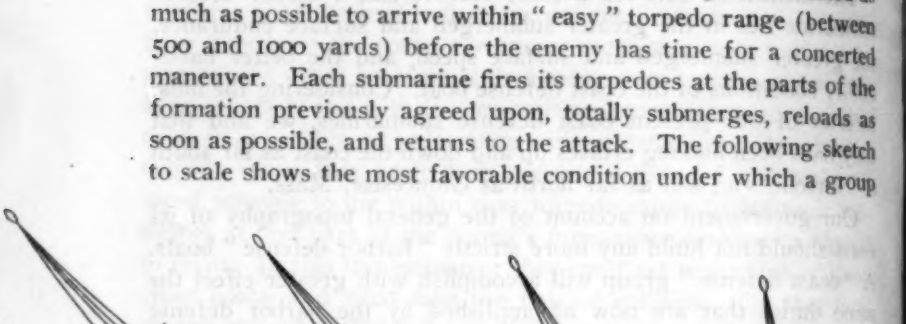


FIG. 2.

of submarines in contact with the enemy can fire their torpedoes. Using torpedoes, capable of angle fire, a four-tube boat should set one torpedo to run five degrees to port of her keel, two to run straight ahead, and one to run five degrees to starboard of her keel.

The movements of each individual boat in contact with the enemy will be dependent on the enemy's formation. Tables showing the proper bearings on which to fire torpedoes with maximum chances of hits, have been compiled for every formation and are readily understood by submarine officers. It is not expected that

every shot will be a hit, nor that every ship of the enemy's force will be disabled. It is hoped that, however, with the above method of firing enough damage will result from the discharge of 20 torpedoes to prevent the enemy from accomplishing his purpose. Attention is also invited to the fact that with accurate knowledge of the enemy's whereabouts off the coast, two or more groups may be despatched to the probable destination of the enemy to deliver an attack as shown above. Under such a condition the other group should attack other parts of the formation. Submarine groups, having exhausted every means of offense, including the torpedoes and ram, should withdraw submerged at low speed or lie on the bottom, if that is possible, until nightfall and then return to the base of supplies under cover of darkness, charging their storage batteries on their way into the base. All attacks so far have been assumed at a moving enemy. Should the attacking group discover the enemy at anchor, landing troops or establishing a base, they should continue as above outlined, totally submerged with only an occasional "porpoise" of short duration until well within torpedo range, when the periscope should be kept submerged until the torpedoes are fired at easy ranges at prearranged parts of the enemy's formation. No special difficulty is anticipated in passing the line of enemy's scouts or pickets with the submarines running totally submerged with occasional "porpoises."

It must be understood that after the reload of torpedoes, the submarines must act absolutely independently, and that it is impossible with the present lack of underwater signal facilities to communicate. In all cases the chief duty and aim of the group commander must be to bring all of his group *into contact with the enemy and within torpedo range at the same time*. Having done this, it is up to the individual commanding officers to produce the desired results.

TACTICS OF AN OFFENSIVE SEA-KEEPING GROUP OF SUBMARINES.

It is not within the province of this discussion to determine the exact tonnage and horse-power of a "sea-keeping" submarine. That information can only be obtained by actual experience in running a group of submarines with a fleet engaged in active war maneuvers. No amount of computation of the number of cubic

feet of space necessary for each person on board will suffice. A "sea-keeping offensive" submarine may be defined as a submarine which can keep the sea, ready for duty under all possible conditions of weather for indefinite periods. Such a submarine group could obtain its supplies from vessels of the fleet which it accompanies, and be in every respect as mobile as any unit of the fleet.

The tactics of such a submarine group after contact with the enemy will be the same as the tactics already described for harbor defense and coast defense submarines in contact with the enemy. The problem of maneuvering such a group into contact with the enemy, or to more accurately state the case, the problem of maneuvering the enemy's fleet into the "submarine danger area" must be solved by the commander-in-chief.

As an illustration of the use of one or more offensive submarine groups accompanying a fleet, let it be assumed that the submarines have a surface speed capable of cruising with the fleet at any speed that may be required to keep up with the fleet. Let it be also assumed that the submerged speed and the radius of the submarines is about twelve knots for one hour, or about eight and one-half knots for four hours, or about five knots for fifteen hours. These assumptions are not excessive. Suppose also that in the cruising formation submarine groups take position on either flank of the fleet. The submarine groups are in the "awash" condition ready for instant use. The commander-in-chief having received information from his scouts of the presence of the enemy, or having sighted the enemy, should immediately send his submarine groups "awash" off on a bearing previously decided upon, and then endeavor to maneuver his opponent into the area occupied by the submarines. The submarines may remain "awash" until the enemy's smoke or masts are sighted. If our commander-in-chief possesses a superior speed he can choose his own situation, and having patience can eventually bring the enemy into the submarine area. If our commander-in-chief possesses the inferior speed he may be forced into action before bringing the enemy into the submarine area. In this case submarine groups should maneuver "awash" or "submerged," as is necessary to keep out of the enemy's sight and endeavor to attack the enemy's formation as soon as possible without interfering with the movements of the commander-in-chief. If our commander-in-chief has the inferior speed and inferior force, and if the enemy is determined to bring

about an action, the problem of making him cross a submarine danger zone is greatly simplified. The appearance of several groups of submarines within or very close to his formation just before a general gun action would undoubtedly cause the enemy to so alter his plans and formation that he would be at a temporary disadvantage, and at the mercy of our fleet. Even if all the torpedo shots missed, the effect on the morale of the enemy would be sufficient to give our commander-in-chief a temporary advantage. Most of the important fleet actions have been fought in sight of land or close enough to shoals to cause the movements of the vessels in action to be somewhat restricted as to courses. In cases of this character the commander-in-chief can so station his submarine groups as to increase the chances of forcing the enemy into the submarine danger area. The commander-in-chief must make a careful study of the areas in which fleet actions may be anticipated in order to utilize to their maximum value the capabilities of the submarines in his fleet. If the commander-in-chief desires to withhhold the submarine attack until after the gun fire, the submarine group should be kept in the background within easy radio signal distance, but in doing this, the commander-in-chief must realize that it will be more difficult for the submarine groups to make a successful dash across the space between the engaged fleets, due to the inferior submerged speed of the submarines. Ships of the enemy that are already disabled would in such cases become easy prey for the submarines. Submarine groups accompanying a fleet are decidedly offensive weapons and of the greatest value when used just preceding a general gun action.

A ruse which might assist in forcing the enemy to keep away from certain areas and thus increase the chances of making the enemy cross the submarine danger zone would consist of having the fast scouts of the fleet drop numerous poles, properly weighted, to float upright in the water, and painted to look like a submarine's periscope. These same dummy periscopes floated out of a harbor with an ebb tide or dropped outside by scouts or fishermen may greatly influence the movements of an enemy sighting them. It would be extremely difficult to distinguish between dummy and real periscopes, for it is easy for a submarine to lie submerged and stationary with only a small amount of periscope showing.

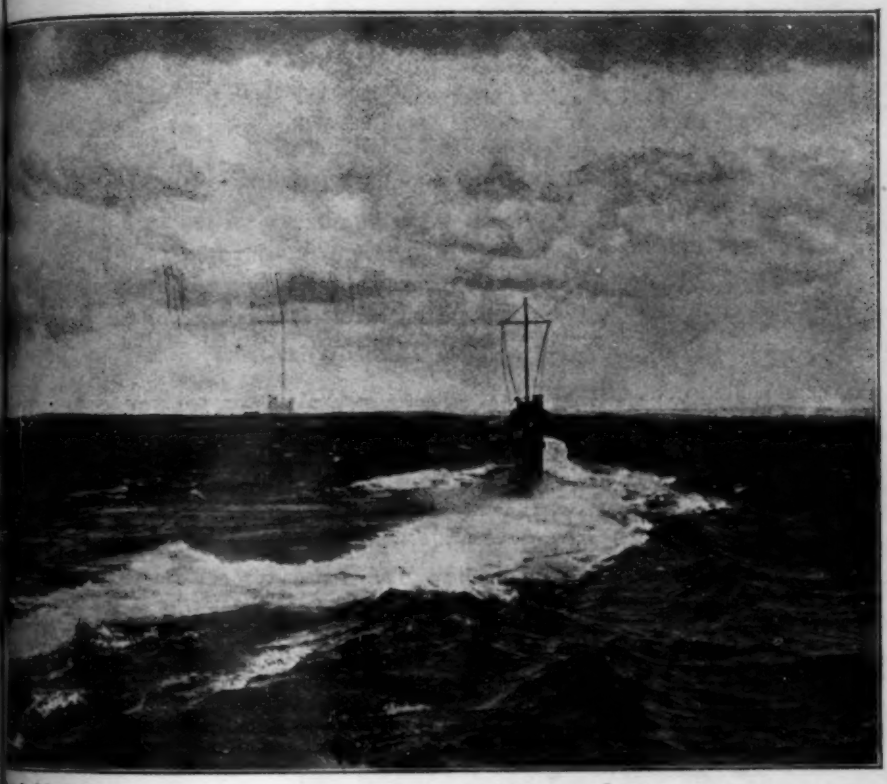
The night maneuvers of submarine craft are the same as for surface torpedo craft, and the same tactics should apply. As there is no possibility of "torching," and as the hull is so low in the water, it is extremely difficult to pick them up at night, even in the full rays of the searchlight. The maneuvers off Provincetown in the summer of 1911 demonstrated that in nearly every case the submarines could come within easy torpedo range of the enemy at night without detection. In a night attack submarines should remain in the "awash" condition, so that in case of self-preservation, or to pass through a picket line, the submarine can quickly run submerged.

RECOGNITION SIGNALS.

At night submarines on the surface will use the same recognition signals used by all surface vessels of the fleet. During daylight operations the problem of recognition is much more difficult. At compartively short ranges, 3000 yards and less, the submarines submerged can recognize a friendly vessel by her silhouette, or at shorter ranges by certain flag or shape signals shown from specific parts of the surface vessel. If surface vessels are fitted with submarine signal apparatus, code recognition signals may be sent, using the bell within the limited distances mentioned in this discussion. By properly screening a submarine bell it is quite possible to send the sound waves out on a line of bearing, or at least within a very small arc. However, in the absence of the submarine bell the battleships or surface vessels must rely on their flag or shape signals to make themselves known as friends. The submarine has only two methods of recognition signals at her disposal, one, sounding code words or letters on her bell, and the other, carrying a certain shaped flag or pennant on her periscope. It would seem that the submarine bell methods would be more efficient at greater distances than the other method, but it has the disadvantage of warning friend and foe alike of the presence of submarines. From a submarine officer's point of view it would seem far better to trust to the judgment of the commanding officer of the submarine to recognize friendly vessels, which he could most certainly do from a silhouette diagram at comparatively long ranges. After recognizing a friend a submarine may rise to the surface and exhibit surface recognition signals, if such are necessary. This method, however, might endanger the submarine

before she is recognized as a friend. The submarine officer desirous of getting within easy torpedo range would be very loath to disclose his bearing to a probable enemy by sounding his bell.

A logical and fairly accurate answer to all points under discussion can only be found by continuous combined battle maneuvers, using all the necessary units of a fleet.



SUBMARINE CRUISING ON SURFACE MAKING A TURN.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE STRATEGIC NAVAL WAR GAME OR CHART MANEUVER.*

By CAPTAIN W. MCCARTY LITTLE, U. S. Navy.

1. MOTTO: "NECESSITY IS THE MOTHER OF INVENTION."

If it were not for the stimulus of necessity, all effort in the world would stop, and the universe would come to an end. Therefore if we want to spur up action, and the *real* necessity is not available, we must create an *artificial* one.

"Assume a virtue if you have it not."

2. THE NAME "WAR GAME" *vs.* "CHART MANEUVER."

In embarking on this lecture I would like to say, by way of preface, that the name Game, *War Game,* has had much the same depreciating effect as the term *Sham Fight* has had with regard to field maneuvers. To avoid this the army has had recourse to the expression *Map Maneuver.* We, of the navy, may in like manner say *Chart Maneuver,* and we have lately decided so to do. There is a further reason why it is well for us to prefer that term, namely, that it accentuates the fact that the strategist's real field of operations is the chart, just as the architect's real field is the drawing board; indeed, Jomini calls Strategy *"War on the Map."*

Still, war itself has been declared to be a game, and rightly so, for it has the game characteristic of the presence of an antagonist. It has, however, another characteristic which differentiates it from most other games. The latter are played for sport; and good sport requires reasonable chances of winning for each side, and aims to give amusement even to the losers. In the game of war, on the other hand, the stake is life itself, nay, infinitely greater, it may be the life of the nation, it certainly is its honor. We are

*A lecture delivered at the Naval War College.

its champions; what sort of a figure shall we cut when, at the tournament, the trumpets sound the charge, and it is found that we have neglected to practice in the joust. What fencing is to the swordsman, what the jousting field was to the knight, the war game is to the modern strategist; and I hope to show that it is even a great deal more.

3. NATURE OF GENIUS.

For many years it was believed that good shots were born, not made; and it is only quite lately that this fallacy has been laid bare. So, too, has it been very generally held that the skill which wins wars was a gift from above.*

That we could apply the same methods to the acquirement of skill in conducting war that we use in learning to play marbles or football does not seem generally to have been suspected.

Marshal Soult said, however, that "that which is called an inspiration is simply a calculation rapidly made"; and another great authority has said that "inspiration was frequently but a timely recollection," which is but a paraphrase of the saying that the "soul of wit is apt quotation."

Napoleon has himself revealed to us what is to be thought of *his* innate genius, when, in a conversation with Senator Roederer, the 6th of March, 1809, he said:

> As for myself, I am always at work, I meditate a great deal. If I seem always prepared to reply to all, to meet all, it is that before undertaking anything, I have meditated a long time, I have foreseen what might occur. It is not a genius which reveals to me suddenly, in secret, what I am to say or do in an emergency by the rest of people unexpected—it is my reflection, it is my meditation. I am constantly at work, at meals, at the theater; at night I get up to work.

The distinguished French military writer, from whom the above is quoted,† General Pierron, in an attempt to ferret out the secret of Napoleon's wonderful military capacity, has discovered that the main points of his most brilliant campaign, the campaign in Italy of 1796, were taken from the Memoires of the Marshal de Maillebois, who had commanded in that theater fifty years before

* Of course we are speaking here of skill, and not of natural aptitude for acquiring skill, which is quite another thing.

† Comment s'est formé le Génie Militaire de Napoléon 1^er^, by General Pierron.

(1746), and from a paper of General de Bourcet, in which there is a review of operations in Italy in 1733.

It is not generally known that before assuming command of the Army of Italy, Napoleon had previously served in the same army as chief of artillery, and from there was transferred to the general staff in Paris, where he prepared a plan of campaign for that army, at which time he saw the books referred to.

In a conversation on this subject the late Major Churchill of the army related the two following stories in illustration:

An officer who had served on the staff of General Sherman in the March to the Sea, was telling Major Churchill of the General's wonderful, intuitive grasp of terrain, and gave as an example how one day the General was laying out the order of march, and said such a column will ford the Chattahoochee at such a point."—"General, there isn't any ford shown on the map; hadn't we better send a reconnoitering party to find out?"—"Oh, no; I'm sure they will be able to find a ford there somewhere," and sure enough they did!

Then the Major laughed; for he remembered that when he was a boy accompanying his father, Colonel Churchill, who was conducting the survey of that section, Lieutenant Wm. Tecumseh Sherman, of the third artillery, reported for duty, and that Lieutenant Sherman and he had crossed that ford together many a time!

The other story was that a man was insisting on the intuitive, inborn instinct of sign reading possessed by the Indians. "Oh, said his companion, "the white man could do the same under proper training."—"Never, never in the world!"

Just then the rattle was heard of an ice cart passing in the street. "What's that?"—"That's an ice cart."—"How did you know that? An Indian would have thought that wonderful."

4. SCIENTIFIC MANAGEMENT.

We all know how in the early part of the last century Germany set industriously to work with all the national thoroughness to apply what it is to-day becoming fashionable to call "scientific management" to the solution of the problem of conducting war.

5. THE KRIEGSSPIEL.

In 1824 Lieutenant v. Reiswitz, of the Prussian Artillery, adapted to the purposes of serious military instruction and investigation a game of war invented by his father; and we read that soon after this v. Moltke was president of a society to play the game. This shows that v. Moltke early became awake to its great importance. When in 1866 Prussia, out of half a century of peace, overthrew the power of Austria in a six weeks' campaign, and, four years after in a struggle with France who had had the benefit of the experience of several wars, succeeded in rolling her antagonist in the dust, the world realized the value of systematic scientific training; and it was generally admitted that the war game was a notable factor in the result.

There were a few French officers, just previous to 1870, who had sounded the alarm; but they were pooh-poohed in the way more or less familiar to us; while Marshal LeBoeuf, the French commander-in-chief, told the emperor that the army was ready—"jusqu 'au dernier bouton de guêtre,"—to the last gaiter button.

There is perhaps more in this answer than at first appears, for it would seem to suggest that his mind, much like that of many naval officers of recent years, was more centered on the materiel, than on the "management."

So, when the time of mobilization arrived, there was confusion worse confounded, much like the later experience of other nations who were not warned by the "horrible example."

The war game being thus brought prominently to view, naval officers began to ask themselves if the game could not be adapted to naval use; and thus began the movement which led to its being now generally adopted.

6. CLERK'S ANTICIPATION OF AND USE OF THE WAR GAME.

Although the use of the war game to-day in the navy was suggested by the German Army Kriegsspiel, brought prominently to view in 1870; yet it is true that, in the latter part of the eighteenth century, Clerk, "The Laird of Eldin," made use of what was practically the same thing for his solution of the tactical problem of his time, as we may see from the following extracts from the Introduction to Clerk's Naval Tactics:

"The splendid results which followed Mr. Clerk's discoveries in naval tactics sufficiently attest their value and importance. The publication of his theory forms indeed an era in the annals of maritime war. If we look to the battles which were fought prior to this, we find, notwithstanding the valor and enterprise both of our officers and seamen, that, with few exceptions, they were all indecisive and unprofitable. The object of our enemies, conscious of inferiority in close action, was to avoid battle, and to act entirely on the defensive; and for this purpose they had brought to perfection a system of skilful maneuvers, by which they always contrived to disable and keep at a distance the hostile fleets of Britain.

"Hence the British commanders were always foiled in their attempts to force on a close action; and though they often encountered the enemy's fleets, they generally parted, after some indecisive and distant cannonades.

"The simple, bold, and decisive maneuver of passing through the enemy's line, suggested by Clerk, and of which he demonstrated the efficacy in a variety of the most conclusive illustrations, effected a complete revolution in maritime war, and gave a new and brilliant aspect to our naval history. The conflicts of hostile fleets were no longer signalized by the triumph of defensive tactics. The skilful mode of attack now adopted never failed to bring on a close and general action, in which valor was sure to triumph; and since this period accordingly, a succession of the most brilliant victories has adorned our annals."

Mr. Clerk in his preface says:

As I never was at sea myself, it has been asked, how I should have been able to acquire any knowledge in naval tactics, or should have presumed to suggest my opinion and ideas upon that subject. The following detail, which I trust I shall now be excused from entering upon, will, it is hoped, obviate every prejudice of this kind.

In the course of this explanation and speaking of his study of Byng's Action, he says:

The attack in this battle (Byng's Action) was from the windward: and as it appeared to me extremely ill conducted, the subject occupied my mind for years. In this discussion, I had recourse not only to every species of demonstration, by plans and drawings, but also to the use of a number of small models of ships which, when disposed in proper arrangement, gave most correct representations of hostile fleets, extended each in line of battle; and being easily moved and put into any relative

position required, and thus permanently seen and well considered, every possible idea of naval system could be discussed without the possibility of any dispute.

and further in reference to the war then in progress:

In the meantime, so often as dispatches with descriptions of these battles were brought home, it was my practice to make animadversions, and criticize them by fighting them over and over again, by means of the aforesaid small models of ships, which I constantly carried in my pocket; every table furnishing sea-room sufficient on which to extend and maneuver the opponent fleets at pleasure; and where every naval question, both with respect to situation and movement, even of every individual ship, as well as the fleets themselves, could be animadverted on; in this way not only fixing and establishing my own ideas, but also enabling many landsmen to form a judgment with respect to the subject of tactics as well as myself.

There are for us in these quotations two interesting points:

(1) That a civilian, feeling that there was some reason, not then known, which should account for the want of success to English arms, deliberately set himself to work to find out the reason; succeeded in discovering that what the English admirals had considered as French defeats, were actually successes of the French tactical scheme; succeeded in finding out what that scheme was; and finally sought out, and succeeded in devising plans to break it up, and bring about the destruction of the enemy; . . . and these proved not only plans, but plans which brought overwhelming success.

(2) That to accomplish this he used little blocks representing ships which he moved about on a table representing the sea: practically the naval tactical or fleet war game of to-day!

Here we have before us in this book the successful solving of an important problem of war. The value to us is not so much in the solution itself, which was for a case under very different conditions from those which we now see; but in the fact that we have before us a successful method of solution.

The method stands, both method and appliance.

(The Department should reprint this book, and it should be carefully studied by every officer as a text-book on the method of solving tactical problems.)

7. OBJECT OF THE NAVAL WAR GAME.

The object of the naval war game is to afford a practice field for the acquirement of skill and experience in the conduct or direc-

tion of war, and an experimental and trial ground for the testing of strategic and tactical plans.

The game offers the player the whole world as a theater, and puts no limit to the forces either in numbers or kinds. Any type of ship may be had for the asking, the only requirement being to state its qualities so they may be expressed in game convention. The ships, too, can do what in time of peace is impracticable to the real ships—for example, they can ram the enemy or destroy him with gunfire; they can run all sorts of risks, nay, can be destroyed to prove the inefficacy of a poor plan, and in a twinkling they can be restored for a new trial. And all of these things are at the disposal of any group of officers gratis.

It is unnecessary to call attention to the fact that the real fleet is not at the free disposal even of its own admiral.

While we can give an entire forenoon, if necessary, to work out and analyze a five minute critical movement, we can, on the other hand, dispose of a day, or week, or a month in less than an hour.

After this rehearsal of some of its advantages, it must be admitted that it has facilities greatly in excess of the fleet.

7. "WAR ON THE MAP" COMPARED TO "SAILING ON THE CHART."

Now at first blush it may be a little startling to be told that for the conduct of a naval campaign the presence of the fleet is not necessary. Strategy has been called, as we have seen, *War on the Map*. A little consideration will show that ordinary navigation is merely *sailing on the chart*. A walk on deck gives no idea where the ship is, but a glance at the chart in the cabin does. In like manner it is on the chart that the admiral plans and conducts his cruise.

Even on the *tactical field* with the enemy in sight, the picture on the retina is a distorted representation, which in the mind must be reduced to a proper diagram. The adjoining ship seems large; those further away diminish in proportion to distance; speed across the line of vision seems very great; that along its direction comparatively slow. Even the actual witnesses to a battle do not have a clear idea of what has taken place until it has been reduced to a diagram.

9. JUSTIFICATION OF TACTICAL GAME BOARD'S BIRD'S EYE VIEW.

It has been sometimes objected that it is a mistake to permit the tactical game board to be seen as though from an aeroplane; but the reason why we recognize a friend a couple of miles away is because we know him so well that the slightest indication will suggest all the rest. Therefore it was thought best to train first with a full view, and later to apply the handicap of obstructed vision, just as a chess player would practice first with the board in sight before undertaking to play blindfolded.

10. GENERAL DIVISIONS OF THE GAME.

It may be said that War is, in the theater of operations, to hunt the enemy and fight him; Strategy, to hunt the enemy in order to fight him; and Tactics does the fighting.

Similarly, that Battle is, on the scene of conflict, to seek position and strike; Tactics to seek position in order to strike; and Gunnery does the striking.

There thus appear to be two natural divisions of the game; The strategic game and the tactical game. As information and security cut a large figure in strategy, they form, in practice, the most important part of the strategic game. The handling of scouts and screens, ever ready to take touch with the enemy, has a strong tactical flavor, though the object is chiefly strategic. Since it is on the quick settlement of these contacts that the smooth running of the game largely depends, and since it is on the familiarity with the solutions of such contacts, and a confidence in what an admiral can expect from his subordinates in this respect, that his freedom of planning depends, the skilful handling of scouts and screens may well be made the subject of a class of games by itself. It is a sort of connecting link between the strategical and the tactical.

11. MUST LEARN TO THINK IN GAME CONVENTION.

Now, we must not overlook the fact that the game is a convention just as is the chart or printed page, or indeed language itself; and if we wish to use either, we must learn to think in it. The war game is a cinematographic diagram; and it is as important to us to be able to read it, as to read a chart or a book.

Before leaving this matter we must sound a warning:

The solutions of the game board, being mathematical, are necessarily correct, "errors and omissions excepted," as runs the commercial phrase; but they are dependent on the conditions. The real question is: are the conditions correct? Let us assume for instance a game ship that has certain stated qualities more or less like say the *Delaware*. The question, then, is not: "is this ship like the *Delaware*," but "is the *Delaware* like this ship?" And the reason is because we know positively and accurately what our assumed ship can do, but no one can state accurately what the *Delaware* can do—indeed no actual ship remains the same for any length of time.

12. How the War Game Leads to Seeking Solutions of War Problems.

Let us now follow through the various steps of the game and see how it leads us irresistibly to seek the solution of those problems which will face us when war makes its appearance. To this end let us start with a game of the first magnitude; and let us suppose that we desire to study a certain theater of war, and that we have selected the adversary best suited to our purpose.

The available players are divided into two camps, to one of which is assigned the blue, and to the other the red—the two colors usually used in the game to denote the sides.

A certain number, however, must be reserved for the umpire staff—consisting usually of the umpire, the recorder, an assistant umpire for each side, and, if desired, such other assistants as may prove convenient.

Since a war game is a numerical problem, and the solution is to be a numerical solution, it follows that the quantities involved must have assigned to them positive numerical values, in many cases unknown to the adversary. These values must consequently be fixed by the umpire, and are formulated in what is termed the *situation*, which *situation* states exactly the terms and conditions of the problem.

This statement of the "situation" is divided into two parts, sometimes called respectively the *General Idea* and the *Special Idea*, the General Idea being that part which is known to both sides, and the Special Idea, that which is known only to each.

There may be even a third part, known only to the umpire, as for example, when a given program of weather is to be followed; and of course the details could not be known to the players before the proper time.

Now, the very formulation of the problem compels a preliminary study of the question on the part of those who devise it.

The problem being delivered to the players, each side must make a careful study of the situation, must disentangle from the details of the statement the exact task that has been assigned to it to accomplish—the exact ***mission*** laid upon its shoulders, *i. e.*, just what it has to do. This first step is indispensable. The contemptuous expression of " that man doesn't know what he is about " exactly fits him who has not fulfilled this first step—who has not disentangled from the irrelevant accompanying matter, his exact mission reduced to, and expressed in, its simplest terms.

This done, the problem will already look much simpler.

But there is another point involved: namely, the exact demarcation and fixing of the limits of what we may call the *area of discretion*, the area within which we may use our judgment, and outside of which we may not go. This demarcation is of very great importance; and we have seen here at the College cases in which, from this first step having been neglected, the decision seriously arrived at, after careful consideration, was nothing more than a conclusion to obey the order received, instead of a decision as to how best to obey it, which problem had been entirely overlooked and untouched.

We then proceed to the second step: a consideration of the *difficulties* we have to encounter in accomplishing our mission. Now, these difficulties may be regarded under two heads—those interposed by nature, and those interposed by man, and they call for a study, under the first head, of the terrain or theater, and under the second head, of the enemy and what he can, and probably will do.

I venture to say that we shall have no trouble in agreeing that after this step has been accomplished, the problem will appear much less formidable than it did before, and the reason is because it is the unknown that frightens people to death.

Being now possessed of a good idea of what we shall have to meet, our third step is: to marshal our forces and see what *means* we have to overcome these difficulties; to marshal the various

lines of action opened to our choice, to compare these, weighing the advantages and disadvantages of each.

When this has been carefully accomplished, we shall find ourselves much nearer a state of readiness to take the fourth step—the selection of the best one of these courses of action, or, as the technical term is, the *decision*.

This process which is thus briefly summarized is known as the *estimate of the situation*, and is the first grand step in the game; and let it be noted that it is the war game that has led us to adopt this systematic method described. It was the game that sought the method, and not the method that sought the game.

13. ORDERS. SYSTEM *vs.* NO SYSTEM.

Now that we have decided what we will do, the next step is to issue the necessary orders to carry out our decision. The preparation of these orders brings us face to face with the fact that we have had no system of war orders at all.

The Germans, first players of the Kriegsspiel, under v. Moltke, developed order writing to a high degree, *under the direct stimulus of the war game;* and their system is now the model for all the world, or at least for those who have waked up to the importance of such a system.

Just as it was the Kriegsspiel that led Germany to this work, so has it been the war game that has aroused us to it.

The *campaign order* (called in Germany the *operations order*, and in our army the *field order*) is the subject of a special lecture by another officer,* so it is only necessary here to touch upon it very lightly; but we may state that the exhaustive study given to the operations order has shown that, reduced to its simplest terms, it consists of in its *body* a skeleton of five parts:

The first—the necessary, relevant information.

The second—an outline of the general plan with regard to the force as a whole.

The third—distribution of the work in regard to the working force.

The fourth—distribution of the work in regard to supply, etc.

The fifth—the place where the directing authority can be reached.

*See "Applicatory System of Solving War Problems" on p. 1011 of PROCEEDINGS No. 143.

14. ORGANIZATION *vs.* DISTRIBUTION OF FORCES.

When we come to distribute our forces to carry out our plan, we find that there are two distinct bases of organization: (1st) the natural tactical organization (technically termed "*organization*"), that which, independent of plan, groups the elements into such bodies as makes them easily manageable for administration, handling and assignment, as for example the ship, the division, the squadron, etc.; and (2nd) the organization under the plan, organization by task (technically termed "*distribution of forces*" in contradistinction to "organization," as limited above), as for example *advance scouts, advance screen, flank screen, main body, rear guard, train guard,* etc.

The word *forces* heads the margin which in the formal *combined order* is an abbreviation standing for this expression, *distribution of forces;* and the contents of the *margin,* where one is used, correspond exactly to the caste in the program handed to us in the theater, which gives the characters in the piece and the names of the actors assigned to each.

They are, then, as one might express it in the language of the stage, the characters in the play, the rôles of the plan. To each of these "rôles" or sub-tasks is assigned a suitable portion of the force, avoiding for reasons of administration any unnecessary splitting up of the tactical and administrative groups, indicating for each sub-task the officer responsible for its execution, and leaving him as free as possible in his way of action. This preserves the control of the ensemble, while giving the freest scope to the senior on the spot. Of course, to such sub-task leader, the task assigned to him becomes within *his "area of discretion,"* a similar problem, to be handled similarly to that already described.

15. FREEDOM OF ACTION TO SUBORDINATES.

The temptation for the commander-in-chief, when he has nothing to do in his own sphere of action, to interfere in the *area of discretion* of his subordinates, is very great, and is moreover very dangerous, because it tends to make the commander-in-chief believe that it is his proper business, it tends to dull in the subordinate his sense of responsibility, and, when the commander-in-chief really has got something of his own to do, it seriously, if not fatally, interferes with his freedom of mind properly to attend to it. The only cure for this is proper war game training.

In this connection, I quote from a lecture delivered October, 1910, at the Army War College by Captain W. L. Rodgers, U. S. Navy, not only for the very pertinent ideas expressed on the subject, but also for the testimony it brings on the invaluable influence of the war game. I quote:

Strategy and tactics are intimately bound up with organization and administration. Matters of organization are avowedly subjects of study here (A. W. C.); but administration, as it seems to me, is not acknowledged, although it is actually a subject of instruction in one particular direction where constant iteration must produce an effect in wider fields.

I allude to the map problems which professedly are tactical and strategic studies, but beside are daily made to teach the supreme administrative lesson of "minding one's own business."

Let us take the case of a regiment to assume outpost duties, and the problem is for the colonel to issue the order. If a solution undertakes to go beyond the battalion commanders and give directions to individual companies, the writer is sure to be reminded that he can command three battalions efficiently, but that twelve companies are too much for anyone. Similarly, if in a divisional movement, the divisional order lays down the movement of a brigade in too great detail, it is pointed out as a fault liable to entail disaster by depriving the brigadier of the discretion he ought to exercise.

Such errors as these just mentioned are not tactical ones, they are administrative faults producing tactical results. But as administrative faults they are not peculiar to the military profession, but are general in all classes of business.

Again, take the form of the *field order:* the first paragraph is devoted to information, the second outlines the general plan, the third and fourth distribute the work, and the fifth announces the place where the commander may be reached. Of these five paragraphs only the last is peculiar to the military nature of the order. The other four merely conform to common sense and the general principles of administration, and might be adopted for issuing an order to any business organization.

Indeed, even the fifth paragraph applies to ordinary business, as for example, where the director is called away from town or his office, and desires to leave some particular address at which, in case of necessity, he can be reached directly. The natural place for this would be at the end of the order.

For these reasons I am strongly of the opinion that the broad general principles of administration should be a subject of study here; and I have been much impressed with the great desirability of taking up the analysis and study of military administrative orders following the same lines as those of the field order.

If true of the army, it certainly is true of the navy.

It is very difficult for a superior to deny himself the privilege, which he necessarily has, of attending to as many details as interest him; but gratification in such a course is ruinous to efficiency. But as was said before, the remedy is not to alter organization so as to reduce the commander's right to meddle; the best course is to take away his desire to meddle by teaching him to know better, and that is what the map problems do for everyone who profits by them, and may be done in still greater degree by study of the principles of administration in general.

And later on in the lecture he writes, speaking of General Grant:

There is a vast store of administrative wisdom in his reply to Sheridan when the latter telegraphed him in the Appomattox campaign that Lee would surrender "*if things were pressed*," and Grant answered "*press things.*"

For a contrast, it is interesting to compare this order with that of Johnston for the advance on Shiloh. At Shiloh, everybody, including the commander-in-chief, was tactically tied up by administrative meddling. At Appomattox, Sheridan was perfectly free to act according to circumstances, and had received the assurance of support in Grant's two words of reply.

16. PLANS HANDED IN AND GAME BEGINS.

The plan of campaign having been determined upon and the preliminary orders having been written out, the commander-in-chief on each side assigns his assistants, so that for each independent acting body there shall be if possible a player.

The sub-task leaders then make out *their* plans and, where necessary, *their* orders.

While one side has been thus employed, the other side has not been idle, and at last both have handed in their plans and orders to the umpire, and the second grand step in the game has been taken.

It is now time for the third and final step—the culmination, toward which everything has been working, and for which the previous steps have been but the preparation—namely, the test or trial. "The proof of the pudding is in the eating."

The umpire being thus in possession of both plans, looks them over, and announces the length of the first move.

Each player then plots his projected move on his own chart, makes a tracing on what is called a transfer sheet, and sends this in to the recorder, who transfers them all to the umpire's chart.

The umpire thus has before him the projected move of both sides. If no contacts develop, nor any information that would cause any player to modify his move, the second move will be an-

nounced, and the first move thereby stands confirmed. If, on the other hand, there be contact or information, it is transmitted by or through the umpire at the proper time to the affected party, and he is permitted to modify his move in accordance therewith, starting from the *game* time at which the word reached him.

The rules for values, contacts, etc., are all laid down in the book of rules, and it is unnecessary here to go into those details; therefore, we will pass on to the types of problems that will develop as the game proceeds.

17. THE SUB-SITUATIONS WHICH EMERGE.

The forces are beginning to move, and are liable to meet the enemy; scouts are being pushed forward to discover the adversary's whereabouts; protecting screens must be thrown out to guard the advancing battle squadrons from surprise; the train and convoys must be protected; or, on the other hand, those of the enemy may have to be attacked. We could proceed down in this way to the smallest detail, but in practice the smaller details are treated in small games, and the results form the basis for conventional rules or summary decisions of the umpire when they arise as incidents of the higher games.

18. PERMISSIBLE DISCRETION DEPENDENT ON ABILITY TO PERFORM SATISFACTORILY.

It is the ability of the subordinate satisfactorily to grapple and solve the problems that may be assigned him as sub-tasks which permits the commander to treat such sub-tasks as, so to speak, the ultimate units of his problem, just as a captain may direct a boat to be manned, or the ship to be ready to sail at a given hour, without burdening his mind further with the details, and feel himself free to deal with the greater question which induced him to cause the boat to be called away, or to desire to sail at the hour named.

In regard to this liberty of action, let us, before passing on, be quite sure that we understand clearly the relation that binds commander and subordinate. The underlying basis is *loyalty to the scheme;* and this of course demands that there be a scheme to be loyal to. While we are urging the commander to grant all possible liberty to his subordinates within the area of their discretion (don't forget the limitation), there is a very sharp distinction between liberty and license: liberty is not the right to do as you

please; it is the right to do *right* as you please; license is the right to do *wrong* as you please. Liberty, we thus see, has a very decided string to it. The radius of the possible area of liberty is directly proportionate to the subordinate's ability to do right, and the freedom which will be granted depends directly on the commander's confidence that the subordinate, left to himself, will deal correctly with the situation.

If in addition there be a common "doctrine" between the two, mutual confidence will result, and they will understand each other, as the French would say, with "half a word."

It is thus directly to the interest both of the commander and subordinates that the latter be trained to do right naturally, that the right be made the line of least resistance; and it is up to the commander to see that they get the opportunity.

A newspaper has lately printed an anecdote, the authenticity of which is not guaranteed; but "*se non è vero è ben trovato.*" It is to the effect that:

While a certain distinguished officer was instructor at West Point he gave the following problem:

The flagstaff at your station has fallen down. Your commanding officer directs you to get it up again. You have under your command a sergeant and twelve men of the Engineer Corps. How would you go about it?

Various schemes were submitted. All wrong, said the instructor. You simply order: "Sergeant, put up that flagstaff!"

The key to the solution lies in the words "of the Engineer Corps," which imply in the sergeant and his people the possession of the requisite ability.

19. RESULTS EVOLVED FROM THE GAME.

The principle of the concentration of the fleet, now generally accepted in our navy, was the direct result of a strategic game here at the College in the summer of 1903. Dissemination had been our rule for years, *i. e.*, the ships were divided more or less impartially among the stations "to show the flag" as the expression was; and at that time the same rule was general with other nations. At the beginning of the game most of the conference had never entertained a suspicion that the custom was not perfectly correct; but at the end there was but one voice, and that strong and outspoken for concentration. But this view, which required but the

time of one game thoroughly to capture the entire conference, took many a weary month before by mere argument it could convince all of those of our naval authorities who had not had the privilege or opportunity of "seeing with their eyes." It was some time after this that England adopted the same principle. A game played here about that time and sometimes referred to at the College as that of "*The Double vs. the Triple Alliance*," (in which Russia and Japan figured among the contending powers). caused those who had taken part in it to have but little doubt, at the outbreak of the Russo-Japanese War, of the outcome of that conflict. It may not be unreasonable to believe that, had the Russian Naval General Staff played the Russo-Japanese situation out on chart and board, and had their officers had a little game experience on the same lines, their actual plans would have been very materially different

When the news came of the battle of August 10, and every one was wondering why at sunset, seemingly at the very crisis of the engagement, the Japanese battle squadron withdrew and apparently yielded the field, and all sorts of reasons were being advanced to account for it, we here at the College recognized at once an old friend, and laughingly exclaimed: "Hello! they have hit upon our retiring search curve!"

We can all recall that at sunset of the first day of Tsushima, Togo repeated the same maneuver, that is, drew off the battle squadron and headed for Matsushima, leaving the field to the torpedo boats. And no one can say that on that occasion, at least, it was because Togo felt himself beaten. No, what he did was, during the night to retire in the direction of natural escape of the enemy, so that at dawn he might find himself still outside of them. Then, extending his net, he could turn, and, as the fisherman's expression is, "scoup them in."

Even international law is affected and developed through the influence of this game. During one of the summer games referred to, played a year or two prior to the Russo-Japanese war, a division was driven into a neutral port, and the superior blockading enemy finding himself balked of his quarry made a demand on the neutral to intern the blockaded ships. Up to that time internment, as applied to the sea, had not been considered. It was taken up the next summer, as an international law situation; and, when the emergency arose in the war that followed, the result of the conference's

discussion was practically adopted by our government as the basis of its action.

I think I have shown, as much as can be shown in a short talk, the wonderful instrument that we possess in this game.

20. SECRET OF THE GAME'S POWER.

Now the great secret of its power lies in the existence of the enemy, a live, vigorous enemy in the next room waiting feverishly to take advantage of any of our mistakes, ever ready to puncture any visionary scheme, to haul us down to earth, and, above all, ready and anxious to "carry the war into Africa."

We know the tremendous interest that Greece took in its Olympic games, of the tremendous interest taken to-day in our yacht and boat races, rifle and tennis matches, ball games, billiard and chess tournaments, not only by those taking part, and those witnessing them, but by the public all over the country If we want to excite an interest in war on the chart, we must give opportunity to have it played, and opportunity for at least a reasonable number of people to become sufficiently expert to play games worthy of exciting interest. Fancy what it would be, if a yearly war game could be made to excite the same service interest as the West Point-Annapolis football match!

There were those who in the beginning railed contemptuously at the "ping-pong" or Morris tube; but should any of these have been met at the last battle practices, they would indignantly deny that they ever did such a thing; and such is the treachery of memory that there is no doubt they would believe it!

21. RELATION OF STRATEGY AND TACTICS.

Now, if in listening to what has preceded, we have taken notice of the direction of the lines of development, we must have perceived that the "decision" was the direct consequence of the "mission," that execution is simply the act to carry out the mission; no mission, no decision, and consequently, of course, no action, no fight. Therefore, a fight without a mission is action without purpose, muscle without brain. And this suggests what to some may seem a somewhat novel view of the difference between strategy and tactics—that is, the "inner" or fundamental distinction: Strategy, war from the point of view of the one who has an object to attain,

i. e., the planner; and tactics, war from the point of view of the executor; or something like the distinction between the architect and the builder, the playright and the actor.

While the distinction between strategy and tactics is clear, yet when it comes to laying down the line between the two, we find that they encroach somewhat upon each other's domain, each tending to overlap. This alone is sufficient to show that their movement of approach is from opposite sides. Strategy is the thought seeking its means of execution, and tactics is the means to carry out the desires of the thought.

It follows from what has been said that tactics is the servant of strategy, that every tactical problem should have a strategic setting, or at least keep in view the master idea which it is intended to subserve. That is the reason why tactics left to develop by itself is like servants without a master. They are practically on a vacation, and nothing very valuable may be expected from them under those conditions.

22. TWO WAYS TO APPROACH A SUBJECT.

Yes, there are two ways of approaching any subject: what may be called (1) By the small end; and (2) By the big end.

(1) The small end: the way of the subordinate, the man who obeys. He learns to be skilful within his limited discretion. His necessity, his *im*pelling as well as *com*pelling cause is the order of his superior.

No order; no cause.

(2) The big end: the way of the chief. His compelling cause is the necessity of the problem, the necessity of the situation.

No situation; no necessity.

23. EFFECT OF WANT OF COMPELLING CAUSE ILLUSTRATED IN OUR NAVY DEPARTMENT.

This finds curiously apt illustration in the history of our Navy Department:

In time of peace, the natural thought of the civilian is to a peace navy—there being no war to conduct, there is no compelling necessity for a war conductor, and, in the absence of a compelling necessity the Department was *organized without that element!*

There being no provision for war directing co-ordination, each bureau or specialist branch drifted toward independent sovereignty—like the states under the old Confederation which preceded the Constitution.

The Civil War came, and departmental chaos gave way to a scrub strategy board, which in turn gave way to an assistant secretaryship filled by an ex-naval officer—not, however, without wading through Pinaforean experiences before reaching some sort of possible system. It was this very thing which during the Civil War awakened the founder of this institution, Rear-Admiral Luce, to the necessity of a War College.

Well, the war over, came the time of cutting to a peace basis; and what more obvious for the first cut than the war directing secretaryship, now no longer "necessary!"

Next came a couple or so of still-born wars with the inevitable hurried, temporary expedients; and finally in 1898, the war with Spain. This time it is a strategy board.

After the war was declared, this board was hurriedly, as usual, organized and assembled in the same makeshift way. And here, too, following the same seemingly inexorable law: the war over, and our experience having shown the board to be very valuable, indeed in war indispensable, it was, as usual, promptly passed into the scrap heap.

24. THE SOLUTION.

WHAT THEN IS THE TROUBLE? *It is in the want of a compelling necessity.*

How then shall we supply this compelling necessity? As, in our history, war seems to have been the only thing that has had the requisite power to compel, and as we cannot have *actual* war in time of peace, why not have recourse to *artificial war?* It possesses the advantages without the disadvantages, has proved itself fully adequate to the purpose in the case of Germany and Japan; and here in our own case, notwithstanding the very limited opportunities we have had for its exercise, it has already exerted such an influence for good as to justify us in expecting much greater things when properly utilized.

25. CONCLUSION.

And now, gentlemen, in conclusion:

Success in any art may be regarded as the product of three factors:

a—the right thing,
b—rightly applied,
c—in time.

If either of these factors is zero, the result will be zero. The right thing rightly applied too late, the right thing misapplied, and the wrong thing, whether applied or not—neither of these combinations promises success.

When from a study of the experience of past wars, and of that of *artificial* wars checked up by suitable trials in the fleet, we shall have discovered what is the "RIGHT THING"; when, by the practice of artificial war, we shall have so familiarized ourselves with the various theaters of war, the situations and their appropriate solutions, that we can see "THE RIGHT THING," "RIGHTLY APPLIED"; and finally when, by persistent practice of artificial war, we shall have so trained our appropriate mental muscles (the mental processes), that the proper line of reasoning has become the *line of least resistance*, so that we shall think right even if we have no time to think at all—instinctively, actually quicker than thought—thus enabling us to do the "RIGHT THING," "RIGHTLY APPLIED," "IN TIME," then, and then only, shall we fully realize the true meaning of the saying that "the best school of war is war!"

Steam applied does work; steam unapplied is but hot air. In the words of Captain Jack Bunsby: "The bearings of this observation lays in the application on it."

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE NAVAL WAR COLLEGE COURSE.[1]

By CAPTAIN W. L. RODGERS, U. S. Navy.

On September 30th the War College completed its twenty-seventh summer course and at the same time its first long course of sixteen months.

The attendance during the summer was larger than in previous years and the results were proportionately better, as the larger the attendance the better the work done. As the object of the courses is preparation for war, it is second in importance to no other duty, and the attendance cannot be too large. Those who have taken the courses realize their highly practical nature, and the advantages derived from them. As many officers as practicable should take the courses, and selection for them should be regarded as a compliment, as is the case in the army with the Army War College.

The long course began on June 1, 1911, and has thus lasted sixteen months. It was identical with the short or summer course of 1911 for the first four months; and a continuation of that summer course for another eight months until June 1, 1912, when the summer course began for a new class, and the long course officers took up, for their second summer, an advanced line of work distinct from that of the new comers.

The work of the War College is professional training, but it is of a kind entirely different from that given at the Naval Academy and its allied post-graduate courses.

Commanding officers, of whatever grade, have duties of two kinds. The first includes all the administrative duties relating to the care and maintenance of the command whose object is to develop efficiency and preserve safety.

[1] A report made to the Secretary of the Navy under date of October 18, 1912.

Studies relating to these administrative duties are pursued at the Naval Academy, and include the technical courses relating to ships and material and the management of the same, and also drills, etc., belonging to the management of the personnel.

The second kind of duty falling to commanding officers is that concerned with leadership. To this belong all those dealing with the military employment and utilization of the force which the commander has under his control. The studies referring to this kind of duties are pursued at the War College, and, unlike those of the first kind, their ultimate object is to promote the military efficiency of the individual rather than that of his command.

The subjects of study at the War College are national and military policies, strategy, tactics, and logistics.[2] But as the success of strategic and tactical movements rests on a foundation of sound organization and administration, it is necessary to include these latter subjects also in the courses.

Further, the War College course includes international law. This subject, as far as it relates to naval affairs, belongs naturally to the kind of studies here pursued as it is intimately connected with strategy and tactics. These latter arts are concerned with the commander's use of the forces at his disposal, while international law deals with the limitations placed on the commander's freedom of action in carrying out his strategic and tactical plans. Thus the whole group of subjects studied here are closely knit as bearing on the practice of war.

The international law situations brought before the conference here always deal with subjects of present interest upon which the law and practice have not yet fully developed a general rule of action.

The solutions are published each year by the Navy Department. They are distributed not only to the navy, but they are called for by public libraries and students of international law, and have a high reputation abroad. They have had a marked effect in modifying recent development of international law.

In conducting the course at the College the object has been twofold; 1st to study naval and military history and to place the principles of warfare on a sound basis, and 2nd, to acquaint the service

[2] A paper on this subject by the War College Staff will shortly appear in the PROCEEDINGS.

with these principles, and with their practical application to war, so that when war comes it will find prevailing among all the individual officers a common school of thought, and a common doctrine of practicing war which will ensure harmonious action and co-operation in all parts of a command.

This plan is carried out by what is known as the applicatory system, which is an employment of the principles of sub-caliber target practice in strategic and tactical situations. A series of situations are issued for study and solution by the individual members of the class.

So far as concerns the mental processes that are acquired in dealing with each situation, the conditions are those of war itself, and by handling many such situations the student becomes expert in dealing with them, so that the real war confronts him, only the physical shock of battle is unfamiliar to him.

These situations, in the way they are dealt with, form subjects for three different exercises, namely:

1. Formulation of orders.
2. {Tactical / Strategic} Problems.[3]
3. {Tactical / Strategic} Chart maneuvers.[4]

The *Formulation of Orders* is an exercise in administration, and deals with the proper organization of the command for the special task in hand, with the proper distribution of tasks to the subordinate leaders, with the supervision and proper degree of control to be exercised, and with the freedom to be permitted to subordinates.

The *Problem* deals with the initial phase of a situation, and is made a means of inculcating logical methods of considering tactical situations, and of making sure that important features are not overlooked. It is also a means of exercising and encouraging boldness and promptitude of decision in emergencies.

In the *Chart Maneuvers*, the two sides are pitted against each other and a situation, instead of remaining an isolated phase as in the problem, is developed into a series of successive and related phases reproducing a campaign or a battle in miniature. In ad-

[3] See PROCEEDINGS, No. 143, Sept. 1912, p. 1011.
[4] See PROCEEDINGS, No. 144, Dec. 1912, p. 1213.

dition, the individual members of the class are assigned the task of writing one or more theses on various tactical and strategic subjects, which are read to the assembled conference and discussed to the advantage of all present. Officers of the navy and civilians of distinction are also invited to read papers on subjects related to the War College work.

The result of such work is no longer doubtful. It is possible to note during the course that those taking it grow in readiness to accept responsibility, and in capacity to exercise high command; and in this our experience is the same as that of other nations. No officer expecting important command can afford to forego the course at the War College. Experience in command during peace offers no analogy to it, and all officers should be ordered to the College as opportunity offers.

I desire to point out, however, that the most desirable time for any individual to come here is when he is considerably younger than has hitherto been the general practice of the Department.

I think that between 30 and 35 years is the age at which it is most profitable to the individual and to the service for officers first to attend the War College.

Before thirty years, one lacks sufficient foundation of experience, while the longer one puts off attendance after passing thirty-five, the more difficult it is to grasp and accept the new line of thought and the professional training which is presented.

Moreover, a course at the College at a comparatively early age exercises a better and more continuous influence upon the service because the earlier one comes, the longer before his retirement he is practicing, and therefore teaching, what he has learned.

At present the War College can accommodate about 45 officers in addition to the staff of the College.

I recommend that the annual detail for the College be established at 15 for the short course, beginning June 1 and lasting to September 30, and 15 more for the long course beginning at the same time and lasting till September 30 of the subsequent year. This arrangement will fill the College each summer, as the remaining 15 will consist of those of the previous summer who are finishing their long course. Of the annual number detailed, I recommend that one-half be lieutenant-commanders and lieutenants within two years of promotion.

The work of the staff is arduous, as the work of the class must

be closely supervised and, besides, the staff must do original work in the preparation of situations, etc., investigation of principles, etc., which is independent of the size of the class. For this reason it is desirable to have the staff larger than at present; and, including the president, it should be increased to ten members. This would give an organization as follows:

1. President.
2. Secretary and keeper of confidential archives and general administration.
3. International law to work with professor of international law.
4. Military subjects—Marine officer.
5. Army War College detail to keep in touch with the army and army methods.
6. Historical studies in tactics and strategy for application in the chart maneuvers.
7. } Instruction in strategic problems and maneuvers.
8. }
9. } Instruction in tactics, problems and maneuvers.
10. }

As officers versed in these branches are not numerous in the navy, the chief source of supply is to obtain them from the class at the College by retaining those who show aptitude in this line after completing sixteen months of study, so that they break joints with their predecessors and ensure a continuity in the development of the course. It is desirable for this reason that the tour of duty of members of the staff should not be cut short, and I recommend that the detail of members of the staff be made for three years including the sixteen months of preparation in the long course.

The above recommendations concerning the augmentation of both the staff and the attendance at the Naval War College are based upon the undisputed fact that heretofore there has not been given to the instruction of officers in the art of war the attention that its importance clearly demands. The result is that an insignificant proportion of officers have taken advantage of the opportunity to obtain this instruction which the War College offers, and as a consequence there is no unity of opinion as to how war should be conducted, either strategically or tactically.

The Assistant Secretary of the Navy stated at the opening of the Summer Conference of this year:

> I fear that at times the importance of the study of the art of war is lost sight of.
>
> It is most desirable that the work of the War College be emphasized.
>
> Only by a careful preparation on these lines (study of past wars, the experience of others, consideration of all possible contingencies, etc.) can an officer adequately supplement the technical and administrative training he obtains elsewhere. No line officer is fully qualified for command unless and until he has made such a study, and this War College was established and is maintained to afford suitable opportunity for such study.
>
> Next to actual war, a well-planned War College course affords the best opportunity for such development thus far devised.

It is in view of these admitted facts, and of the manifest imperative necessity of establishing with the least practical delay a doctrine of war generally understood and accepted by the officers of the service, and of the fact that this can be accomplished only through the work of the War College in training officers, that I urge that the output of the College in trained officers should, at least in the immediate future, be as great as practicable.

Moreover, since, in the meantime, the instruction of the officers of the fleet in knowledge of the art of war must necessarily depend upon the knowledge of war possessed by its commanding officers, it would seem apparent that, in so far as practicable, all officers should, before being ordered to important commands, be required to take at least the short course at the College—this practice to be continued until the younger students (from 30 to 35 years) recommended above, reach the command grades.

In conclusion it is well to say that these recommendations are in accord with the policy advanced by my predecessor at the War College in his letter to the General Board of October 19, 1911.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

MENTAL AND MORAL TRAINING FOR WAR.*

By SURGEON J. F. LEYS, U. S. Navy.

In a lecture† delivered before the War College Conference by Professor Hugo Munsterberg in June, 1912, the psychological conditions existing in war were described.

In the preparation of this paper an attempt is made to arrive, if possible, at some conculsions which may be of a practical character. Interesting as the subject of mass psychology is, it can have no value in this course if its interest is purely academic. The question for us is: In the preparation for war can anything be done in the way of mental and moral training which will, under the psychological conditions of war, contribute to our success in arms? Apparently some preparation of this sort is possible.

The preparation of the individual for war begins long before his enlistment in the armed forces of the country, or his attainment of adult age. Lieut.-Colonel Montaigne, of the French General Staff, says: "The preparation of a race for war is made by its mothers and its schoolmasters." And in another connection he states that war in its essence is not an art or a science, but a morality (*moralité*); that is, a moral system or idea. This is true or it is not true. War is right or it is wrong. It is necessary or it is unnecessary. Under our free institutions every individual, educated or uneducated, will not only have his opinion but will freely express it. But that war is necessary and right is the opinion based upon history. The contrary opinion is at variance with the dominant fact in all history, that the racial progress and national development of mankind have been accom-

*Lecture delivered at the Summer Conference, U. S. Naval War College, Newport, R. I., September 18, 1912.

†In Archives, Naval War College.

plished with the waging of war, and by it. A theory that the same progress might have been accomplished without war is untenable because it is nothing but a theory, based on no fact. With this moral philosophy of war the biological law of evolution is entirely in accord. "It is the destiny of the weaker to serve as food for the stronger, the purpose which the weaker exists to fulfill. The stronger develops its strength in conquering the weaker and this is *its* destiny. Might is right" (Montaigne). This is not a mere political theory. It is a biological fact.

It behooves us then, in our national preparation for war, to look to our schools. Are our children receiving in the majority of our schools, public and private, the sound teaching supported by history and biology that war is inevitable, necessary, right, a moral idea? Field Marshal Count Moltke says:

> Selfish and worldly activity, looking only toward the gratification of all desires of the individual, undermines the foundations of higher moral philosophy and the belief in ideals. Fools arrive at the vain conclusion that the life object of the individual is acquisition and enjoyment; that the purpose of the state is simply to facilitate the business affairs of its citizens; that man is appointed by an all-wise Providence to buy cheaply and sell at a profit; they conclude that war, which interferes with these activities, is the greatest evil.

It is to be feared that too many of our children are receiving either such false teaching or no teaching at all. Too many of our boys attend schools where virile influences are lacking. Co-education of the sexes is carried too far up in age. Boys should not be taught to so large an extent by spinsters. Boys should go to school to men and girls to women. The revival of the schoolmaster as an honorable, honored, and well-paid position for the highly and soundly educated man is a national need, of direct importance to the future security and defence of the nation.

The pulpit and the newspaper are the schoolmasters of the great mass of our adult citizenship. It cannot be said that either of these influences tends, upon the whole, to inculcate a sound morality with regard to war.

Under the freedom of this government, any private individual, or association, society, or sect has the right, at its own expense, to maintain schools in which its own sons may be brought into a feministic atmosphere and taught an individualistic philosophy, and to employ teachers as incompetent as it pleases. But it is still true that the very large majority of the present active gener-

ation of our tax paying and voting citizens are as level headed and right thinking as the citizenship of any other country. The whole public which supports the public schools has a right to demand, and if its active interest in this particular matter could be aroused I believe that it would demand, that public funds should not be expended in public schools for the employment of persons who, through insufficient education, or personal bias, are incapable of giving instruction which squares with the teachings of history and the facts of daily life. Sound teaching in the individual's relation to the state and in his duty to support and defend it should be required, the unsound teachings of mere individualism should be prohibited; and the teacher unable or unwilling to teach in a state school in accordance with principles approved by the state should be considered incompetent and disqualified.

The Navy League might properly concern itself with this aspect of public education, and it might well bring such wholesome influence to bear as it can upon other departments of the Federal Government in this connection. Its attention is invited to a recent publication by the Bureau of Education, at Washington, in its Bulletin No. 8 of 1912.

No one will gainsay now that mental equipment and training for the operations of war is at least quite as important as material preparation. That is the very meaning of the existence of this War College.

Napoleon stated that "in war the moral is to the physical as 3 to 1." A similar opinion seems to have been held by the highest authorities on the subject of war in all times and countries. Anyone who would venture to hold a different opinion should be able to give reasons.

Colonel Montaigne says: "Force is not the number of the personnel, nor the sum of the material, it is 'la vertu.'" Virtue is here used not in a narrow sense but in the broad sense of the Latin *virtus,* manly excellence. So, too, the word *morale,* Latin *mores,* meaning both manners and morals, is used in the broad sense of the Wykhamites whose motto is "Manners makyth Man."

Clausewitz says: "To what would a theory of war degenerate which left the moral qualities out of consideration?—to a mere military arithmetic or a military geometry—that is to say, to a nonsense." Guibert says: "Every battle is a moral battle."

The subject of mental and moral training for war seems to fall naturally into the following divisions:

(1) The training of the individual, whether officer or man, largely a self-training.

(2) The training of the officer as such.

(3) Training and control by officers of the body of men under their command.

(1) Colonel Montaigne says: "The preparation of the soldier for war is to make him hardened against fatigue, insensible to suffering, ready for death. He should enter battle with no mercy for himself and none for his enemy. To eliminate fear he must train himself to despise his own destruction and to be ready to sacrifice himself."

This author (Montaigne) devotes the first 101 royal octavo pages of his book to the subject of fear and a considerable number more to means of overcoming it. He says that a leader may well be more concerned with the dread of fear than with the dread of danger. His conclusion is that the cure for fear and its effects upon the rank and file is in the awe of authority. The remedy for "la peur" in troops is "la crainte," impressed by the severest discipline. Whatever the *applicability* of this idea in other races and under other governments, it is not applied, not practiced, probably not available as a means of controlling or eliminating fear in American troops or naval forces. And it does not seem to me the logical answer to the problem of eliminating fear, and more definitely the fear of death. It is a purely artificial method to employ, and it appears likely in most cases to fail.

Nine-tenths of all fear is the dread of the unknown. Nine-tenths of all fear is eliminated when the unknown becomes known. Suddenly placed in an unaccustomed environment with unknown forces in play around him, the possible effects of which at any moment may be injurious or painful, the individual is possessed by fear. Persons of nervous temperament are more accessible to this influence of the unknown or unaccustomed than those of phlegmatic temperament, but none are quite free from this fear of the unknown. The liability to fear of the unknown and the reflex effects of fear are physical conditions, largely beyond direct control by the higher consciousness. Illustrations could be multiplied indefinitely: The fear of the dark and unfamiliar road, which disappears as it becomes an accustomed walk, the fainting of the

strong man at the sight of his own blood shed in the smallest quantity and even painlessly by the surgeon's lancet, though the same man will undergo the most painful ministrations of the dentist with the nature and extent of whose work he is more familiar, the ducking of a soldier or sailor as a shell hurtles overhead in his first battle, though he sees the absurdity of such a movement with further experience and better knowledge. Fear is removed by familiarity, by knowing the facts. A knowledge of the actual facts concerning death should serve to remove all dread of death as a personally painful experience, for it is not so. The termination of the life processes as a consequence of disease or injury is not a painful phenomenon. It has suited poets, romancers, and to some extent religious preachers so to misrepresent it. To the extent that they have done this it has been part of their stock-in-trade. But this is pure fiction. It is not the stuff with which to feed up the mind that we would make sound and strong. The fact is quite the contrary of this. I have seen a very considerable number of men dying, perhaps as many as two hundred, and I have never seen a dying man afraid to die, nor a final dissolution that was painful. I have compared notes on this subject with many physicians and have always found their experience the same. The fear of death in itself is a fear of the unknown, fed upon false teachings and not justified by any fact. The attitude of the sound and well-regulated mind should be that death may be undesirable and inconvenient for business reasons of a personal or domestic nature, that is all. The naval or military man should make his property secure, take out necessary insurance, make his will, and as far as possible remove anxiety for those dependent on him as a factor tending to disturb his equanimity in approaching hazardous duty. Death will not hurt him personally, at the time, nor will he experience any subsequent ill-effects from the occurrence.

The mentality of man has a physical basis. Mental processes are a function of certain cells. There is no function, secretion, motor discharge, or efferent impulse of any kind from a cell except in obedience to the stimulus of an afferent impulse of some kind reaching that cell. All activity is reflex, none is spontaneous, as non-biologists are too apt to suppose. That *many* actions are reflex is taught in the elementary schools and is well known to the laity, but it is not so well known that *all* vital action

in living animals is so. The reason this is so is a fundamental one. It rests upon the cell-doctrine of life. Man is but a community of highly specialized individual cells. The cells of his brain and nervous system are cells in which the fundamental vital property of irritability, common to all cells, has been highly specialized. The activity of the mind, like every other vital process is a cell-function. A man cannot do anything his cells cannot do, for he is nothing but a mass of specialized cells. Mental health and strength have the same kind of physical basis as powers of a grosser sort.

If you approach the problem of developing and maintaining your individual efficiency with these fundamental facts clear to you, the relation of a cell-poison such as alcohol to your efficiency will be clearer than any moralist who confines his arguments to the abstract can make it. Von Moltke said "Beer is a more dangerous enemy to Germany than all the armies of France."

The higher centers, the centers of conscious mind, take cognizance of many actions, choosing and controlling the motor discharge with which response is made to the afferent stimulus received. But when the same afferent impulse leads many times to the same motor discharge, habit is established, the higher centers cease to exercise attention to the action, and to choose, direct or modify the motor discharge. Such habitual reflexes are said to be carried out by the *subconscious mind* without the cognizance and control of the *conscious mind*. This talk of conscious mind and subconscious mind is a mere *façon de parler*, the jargon of psychology, a convenient formula used because it serves well for purposes of discussion, just as the atomic theory serves in chemistry.

Conscious mind (*i. e.*, the higher centers) may be off the job by reason of complete suspension as in sleep, in the hypnotized state, or in some forms of mental disease. Or it may be off the job because it is being constantly diverted by new impressions, or so disturbed and depressed by fear as to be incapable of functioning in the government of action.

It is here that the value of habit in the individual appears. Under these circumstances, with his higher consciousness benumbed and his judgment suspended, the undisciplined individual will, on the receipt of an afferent impulse, either do nothing, or he will do a wrong thing. But if discipline has established in

him a habit; if his lower centers, on the receipt of an auditory afferent impulse, the bugle call or the word of command, are habituated to giving the appropriate motor discharge, he advances, takes his station, or fires, though his higher mental functions may be in a condition of suspension, or of distraction.

(2) We have now to consider the psychology of the individual officer who is to control the mass of personnel and material, and upon whose individual capacity and staunchness the issue of battle depends. It is upon his moral force, his *morale* in the broadest sense, his virtue (*virtus*) that the issue rests.

Few men are essential or incurable cowards. Brute courage, so-called, freedom from any serious fear of pain or death, is a fairly common commodity, and fairly cheap. You can get it in the market in quantities as required, for about $15.00 a month, and of a quality which will probably not fail you in the hour of need.

Most men, unrestrained by law, will fight, even against odds, for what they want. With moral courage, developed by discipline, they will fight for the rights of others, and sacrifice themselves. But this courage, and the higher manifestations of courage which make up the man's total moral efficiency, or *morale*; and all of a man's moral and mental activities no less than his so-called physical activities have a physical basis.

The activities of his brain are arrested or vitiated by disease as promptly as the activities of his muscles.

The importance of staunchness, self-control and readiness for self-sacrifice, and of good habits in general, is sufficiently emphasized by all authorities on military responsibility and conduct. As to the idea of a special *genius for war*, Clausewitz disposes of this with the opinion that the phrase has no special meaning, that in connection with war the word *genius* is to be taken only in its ordinary sense, "a very high mental capacity for certain employments."

Lieut.-Colonel Foch, of the French General Staff, states that the first trait to be developed in the mental training of the officer is *subordination* and the second *initiative*, no less necessary than the first—that initiative defined by von der Goltz as "The manifestation of the will power of the individual, backed with sound judgment and acting in accordance with the plans of superior authority."

The importance of the study of the art of war needs no emphasis here. Every officer who has had the advantage of the War College Course in recent years appreciates, at its full value, the fact that the mental processes exercised and made familiar and habitual by the strategic game, and those which would be required in the strategy of actual war are identical. The mental training involved in this course is therefore of the highest practical value to the officer who will be charged with responsibility in the prosecution of war. The factors which must be considered in war will range themselves in proper sequence in the mind habituated so to deal with them.

Concerning the effect of the events of war upon the mind (the higher centers), Clausewitz says:

> In war owing to the many and powerful impressions to which the mind is exposed, and, in the uncertainty of all knowledge and of all science, more things occur to distract a man from the road he has entered upon, to make him doubt himself and others, than in any other human activity. . . .
>
> . . . Often nothing else will help us but an imperative maxim which, independent of reflection, at once controls it: that maxim is, in all doubtful cases to adhere to the first opinion, and not to give it up until a clear conviction forces us to do so. We must firmly believe in the superior authority of well tried maxims, and under the dazzling influence of *momentary events* not forget that *their* value is of an inferior stamp.

The necessity of bearing in mind and acting upon this principle has been illustrated in at least one of the problems played out here this summer.

In concluding this part of the subject which has to do with the mental training of the officer, a difference may be pointed out between the conditions surrounding the commander-in-chief of land forces and those in which the commander-in-chief of naval forces must often exercise his highest faculties to arrive at reasoned decision. Clausewitz says:

> So far as the enemy's activity affects the general directly in the matter of danger to his person, this is a factor which plainly diminishes the higher the rank of the commander. To what does this factor amount for one in the post of commander-in-chief? It is nothing.

It is plain that the disturbing factor of immediate personal danger will very often be brought to bear upon the naval commander-in-chief in action; though his most important mental labors will have been discharged, under modern conditions, before battle is joined.

(3) We now come to the third and last subdivision of our subject, the training and control by officers of the body of men under their command. And here, again, naval conditions are in important respects different from those obtaining with land forces. There is little danger of panic in the crew of a modern ship on the way into action. The men below who propel the ship as ordered are not exposed to those impressions which startle the senses, strike with fear, and make for panic in land forces advancing into battle. The commanding authority directs the course. Explosive sounds overhead and about the ship have been made familiar by target practice and have long ceased to be in themselves disturbing. The evolutions of battle practice reproduce with almost perfect similarity the conditions of actual battle. The habit of fixed attention on his proper duties is well developed in each individual, and the strain and fatigue are much the same. The individual who might be seized with panic has no chance to bolt to the rear and be followed by others.

Remember the points of mass psychology, explained more in detail by every writer on this subject. The psychological characteristics of the crowd, whether a theater audience, a mob, a regiment, or a ship's crew, or any other close collection of men brought together by some common interest are:

First, a suspension of the sense of individual responsibility.

Second, an increased susceptibility to suggestion.

Translated into physiological terms, this means that the receipt by the lower centers of the necessary afferent impulse will give rise to an efferent discharge (action) without review and check by the higher centers—which would regulate the action according to reason but for the fact that, in the psychology of the mass, they, the higher centers, are in suspension, prevented from functioning.

In dealing with the mass of men under orders, we have to take every precaution that selection and training can give, that they shall not receive and act upon a wrong suggestion at the critical time. Such a suggestion might be received from gruesome sights to which they are not accustomed.

The physical reflex action (in the direction of panic) which may be produced by the sight of bloodshed, or of mangled bodies, is not a reasoned action controlled by the higher centers. It is not caused by a reasoned feeling of danger to his own person, a

fear that similar injury may at any moment overtake himself. It is entirely independent of this. It is not an intellectual fear but a purely unreasoning, involuntary, physical reflex, produced by the unfamiliar. It is what I have already called *the fear of the unknown*. Precisely the same physical reflex is seen in many medical students at their first surgical clinic, where it is evidently not caused by the presence of any danger to their own persons. Nor is it the effect of sympathy with the sufferings of others. The same physical reflex will be produced in nine out of ten normally strong men who are taken into a dissecting room at night for the first time. The intellect will ridicule and repudiate such a condition, before, during and after the visit, for it has no intellectual basis or justification, but it is there, a physiological reflex, a definite, tangible, physical condition.

These facts indicate that our solution of this end of the psychological problem, how to deal with the mass to be led, lies along these lines.

First. Eliminate as far as possible the fear of the unknown. This is largely accomplished by making familiar, as far as possible, the physical environment of war, which if unfamiliar would tend to astonish and startle the nervous system. Fleet evolutions tend to fortify the mind, unconsciously to itself, against the fear of collision or ramming, or of undetected approach for torpedo attack. Target practice gives familiarity with noise, recoil, the hurtling sound of the shell in the air, all of which would disturb the senses if unfamiliar.

The idea emphasized by the surgeon-general in his address here a year ago, that each battery group in the ship should be made as self-sustaining as possible in the matter of first aid to its own members, both as regards material supplied and skill in its use; and that the medical force of the ship should, as far as possible, go about during the battle and relieve visible suffering, and relieve the men at work from the disturbing effect of gruesome sights; this principle probably has a high psychological importance for efficiency in battle.

Secondly. With a ship's company so well familiarized with fleet exercises and target practice as our men are, it is probable that the first phenomenon noted as characteristic of mass or mob psychology would not, in a naval action, come to the fore to be reckoned with, namely, a suspension of the sense of individual re-

sponsibility. But the other important psychological mass effect would probably be present, namely, *increased susceptibility to suggestion.*

It would be well to accept this as a basis for action, and the action indicated might well have a practical value, especially for the personnel of all those units not in the first line, who would be kept for a time in the suspense of waiting. To make advantageous use of this psychological condition it is necessary to remember what has been proved by laboratory experiments. In normal suggestibility—whether of the individual or of the mass—suggestion may be successfully made by repetition, by frequency, by last impression.

(1) By *repetition* we mean technically the repeating of the suggestion again and again without other impressions intervening.

(2) By *frequency* we mean repetitions at intervals and separated by other impressions. *Frequency* is three times as powerful for effect as *repetition.*

(3) *Last impression.* Of several impressions the last is most likely to be acted upon. Last impression is five times as powerful for effect as *repetition* and nearly twice as powerful as *frequency.*

The strongest suggestion is obtained by a combination of *frequency* and *last impression.*

The application of these principles would be as follows: In a destroyer standing by for her opportunity to make torpedo attack, the officers repeat from time to time, "We'll have them just where we want them bye and bye." This and similar suggestions are frequently made. When the time has come to advance to the attack the order for speed and helm is accompanied with the suggestion, "Now we've got them." Under such conditions each man will be inspired by the suggested confidence in the result.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

LIFE INSURANCE.

By COMMANDER L. M. NULTON, U. S. Navy.

About the time of the cruise of the battleship fleet around the world, the writer, desiring to take out additional life insurance, was confronted with a flood of contracts in which the diversity of the options offered, and the wide range of the *cost per $1000 of insurance*, were bewildering. This led to a study of the insurance question in order to try to intelligently answer for himself the question "What am I really buying, what have I bought in the past, and why is it that the cost per $1000 of insurance is so much greater in some cases than others?" It is believed that the results, if simply stated, might interest the service.

If the average man were to deliberately go into a market and pay his money for an article of his own selection, and then be charged with buying something, and yet be in ignorance of what he had purchased, he would indignantly deny it.

That the above statement as to the ignorance of the purchaser of his purchase is really true in the case of the majority of those purchasing life insurance, is confirmed by writers on life insurance, by agents, and by a casual conversation with almost any policyholder, during which conversation one attempts to have him explain what his policy really grants him and how much this grant actually costs.

Many policies offered to the public are not *life insurance* policies pure and simple. They consist of life insurance combined with all sorts of financial arrangements, so-called investments, annuities, etc., to a degree that is bewildering; but the important point for a would-be policyholder to consider is the fact that, for a given set of insurance conditions, such as age, period cov-

ered by insurance, amount of insurance, etc., the *life insurance cost* is practically the same in every company; and, *in many cases, is only a small fraction of the amount paid in premiums.* It can be further shown that that portion of the contract that represents investment features is very expensive to the policyholder. Especially is this so in the case of salaried men without business opportunities, as, for example, naval officers.

It is not the intention, or desire, of this article to belittle, or attack, life insurance. Real life insurance protection is most desirable, has a definite place in the economics of our present life, and, properly taken out, is a boon to the man of limited means, in his efforts to protect his family. Life insurance in its real sense is *protection* and *not investment.* A writer on life insurance subjects says: "life insurance is and can be nothing except an agreement to pay a determinable sum on death.

"A pure endowment is no more life insurance than is an annuity, or a policy against loss by fire. It is in the varied departures from this essential definition that policies in scores of forms have been issued and called life insurance policies, *while the real life insurance was only part of the contract and usually not the most costly or remunerative part.*

"Life insurance is not an investment. It cannot possibly be. It is a protection, and like fire insurance protection, or any other form of insurance protection, it must be paid for. Its cost is the difference between what the premiums put in a savings bank at compound interest would amount to and what the policyholders receive. That difference in certain forms of insurance, even in the best and most honestly managed companies, has been over 10 per cent, and, in some cases, 25 to 30 per cent."

The principal instruments of all companies in determining the cost of insurance to policyholders consist of (1) mortality tables, and (2) interest tables.

The mortality table assumes that 100,000 persons, aged 10 years, start life together, and tabulates each year thereafter the number of those who die during the coming year, and those of the original 100,000 who are alive at the end of the year.

This table is based on the law of averages, and is the result of the analysis of a mass of statistics collected over wide areas and during long terms of years.

THE AMERICAN EXPERIENCE TABLE OF MORTALITY.

Completed age	Number surviving at each age	Deaths in each year	Completed age	Number surviving at each age	Deaths in each year	Completed age	Number surviving at each age	Deaths in each year
10	100,000	749	40	78,106	765	70	38,569	2,391
11	99,251	746	41	77,341	774	71	36,178	2,448
12	98,505	743	42	76,567	785	72	33,730	2,487
13	97,762	740	43	75,782	797	73	31,243	2,505
14	97,022	737	44	74,985	812	74	28,738	2,501
15	96,285	735	45	74,173	828	75	26,237	2,476
16	95,550	732	46	73,345	848	76	23,761	2,431
17	94,818	729	47	72,497	870	77	21,330	2,369
18	94,089	727	48	71,627	896	78	18,961	2,291
19	93,362	725	49	70,731	927	79	16,670	2,196
20	92,637	723	50	69,804	962	80	14,474	2,091
21	91,914	722	51	68,842	1,001	81	12,383	1,964
22	91,192	721	52	67,841	1,044	82	10,419	1,816
23	90,471	720	53	66,797	1,091	83	8,603	1,648
24	89,751	719	54	65,706	1,143	84	6,955	1,470
25	89,032	718	55	64,563	1,199	85	5,485	1,292
26	88,314	718	56	63,364	1,260	86	4,193	1,114
27	87,596	718	57	62,104	1,325	87	3,079	933
28	86,878	718	58	60,779	1,394	88	2,146	744
29	86,160	719	59	59,385	1,486	89	1,402	555
30	85,441	720	60	57,917	1,546	90	847	385
31	84,721	721	61	56,371	1,628	91	462	246
32	84,000	723	62	54,743	1,713	92	216	137
33	83,277	726	63	53,030	1,800	93	79	58
34	82,551	729	64	51,230	1,889	94	21	18
35	81,822	732	65	49,341	1,980	95	3	3
36	81,090	737	66	47,361	2,070	..	.....	....
37	80,353	742	67	45,291	2,158	..	.....	....
38	79,611	749	68	43,133	2,243	..	.....	....
39	78,862	756	69	40,890	2,321	..	.....	....

The above table starts with 100,000 persons who have attained the age of ten. Of these, 749 will die during the following year; that is to say, before they attain the age of eleven. Those, therefore, who attain the age of eleven will number 99,251, and of these 746 will die before reaching the age of twelve. Only three of the 100,000 will be alive at the age of ninety-five, and presumably these 3 will die during the year; that is to say, before reaching age ninety-six.

The interest table is important because practically all companies base their final charges to the policy purchaser on the assumption,

among other things, that money will earn 3½ per cent compound interest while in the companies' hands for investment. Interest is a factor in every calculation made by a life insurance company.

Before going further, there are two fundamental facts which must be established for a clearer understanding of what follows. These are:

(1) That all life insurance costs something to grant.

(2) That it costs more to grant insurance to an older man than to a young man. In illustration of the first statement, let us assume that all of those 100,000 people, given in the American mortality table, who have lived to reach the age of 35 desire to insure one another for one year for $1000 each.

From the table there are, at age 35, 81,822 people, of whom 732 will die before the end of the year.

Then:

Amount of insurance to be paid $= 732 \times 1000 = \$732{,}000$.

Number of people to pay it (in advance) 81,822.

Cost per $1000 per individual $\frac{732{,}000}{81{,}822} = \$8.94$.

It is thus seen that of the 81,822 people alive to start with, there are still alive at the end of the year 81,090, but as no one of the original 81,822 persons knew whether or not he would be one of the 732 to die during the year, each would have to pay $8.94 premium to insure his heirs receiving $1000 in the event of his death.

The above simple and self-evident fact is given for one purpose only, to emphasize the fact that it costs "a definite sum of money" to carry insurance, even though one may live through an insurance period.

In illustration of the second fact, that it costs more to insure an older man than a younger man, assume that the 100,000 people starting in the American mortality table had not thought of insurance until they were 71 years of age.

The process of determining the premium, under conditions similar to the foregoing, would be as follows:

Number of survivors at age of 71	36,178
Number of deaths during ensuing year	2,448
Amount of insurance to be paid $= 2448 \times 1000 =$	$2,448,000
Number of people to pay it in advance	36,178

Therefore, cost per $1000 for each person insured =

$$\frac{2,448,000}{36,178} = \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \$65.69$$

From the foregoing, it is seen that the cost per individual for $1000 insurance for 1 year, as calculated by this method, is $8.94 at the age of 35 years; and $65.69 at the age of 71 years.

It is to be noted in the foregoing calculations that the premiums calculated are all used in payments to the beneficiaries, and that no money has been used in the ordinary expenses, such as salaries, rent, postage, etc., of the business.

A premium so determined is called a *net premium*, the term signifying only that amount of money which it is necessary to collect from each of the insured to meet the mortality payments alone.

If we were to continue the calculation of net premiums by the method already described, starting with the age of 21, on the assumption: (a) that we would grant insurance only for one year at a time, and (b) would collect only enough money from each one to pay $1000 to the heirs of each person deceased during the coming year, our premiums would be calculated on what is called the *natural system*, and their values at certain ages, would be as tabulated below:

Age.....	21	31	41	51	61	71	81	91
Net natural premium.	$7.62	$8.26	$9.71	$14.11	$28.03	$65.69	$153.99	$516.96

An inspection of the foregoing table shows that the net natural premium is very small at first, but increases rapidly from year to year and is excessive in the later years of life.

As few men desire to carry an increasing burden, the natural premium is very seldom employed and its disadvantages may be met in two ways: (a) by paying in one lump a *single premium*, which, with interest, is the mathematical equivalent of all the natural premiums, or (b) by determining a fixed amount which, if paid each year, will be the equivalent of the natural premium, or of the single premiums. This fixed annual equivalent of the natural premium is called the *level annual premium*, and is used to-day in practically all policies, and by all companies.

The single premium is seldom used, as it is equally inconvenient to the insured because of the large amount involved in one payment.

The comparison between a natural premium and a level premium is illustrated in the following diagram.

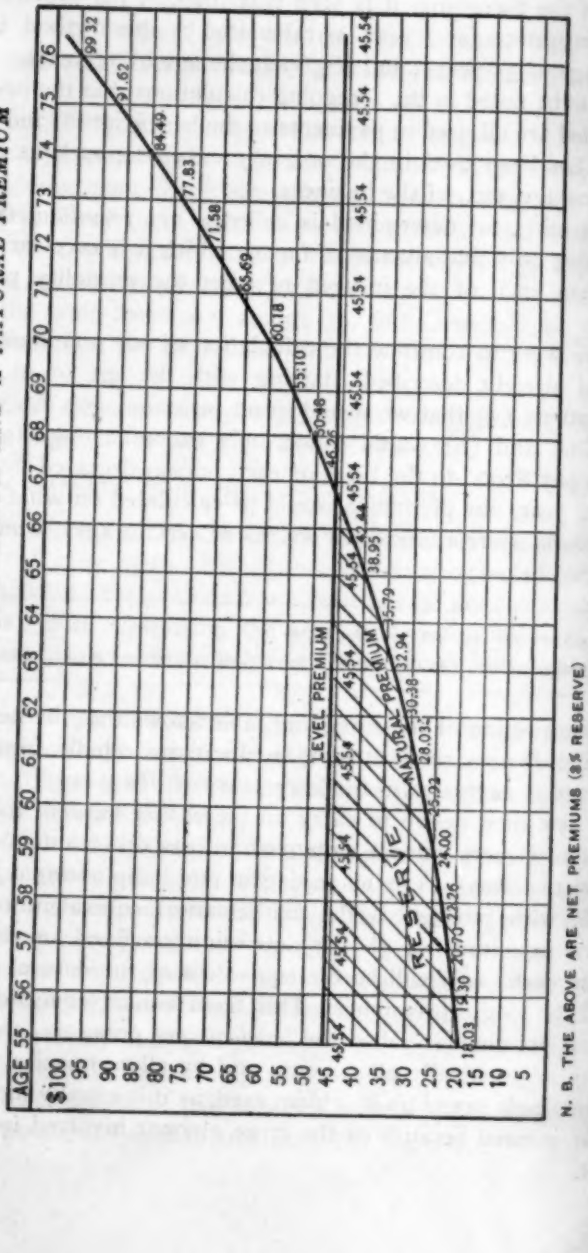

FIG. 1.

In this instance a man fifty-five years of age, having taken out two policies for $1000 each, would pay the first year, on his natural premium policy, the sum of $18.03, which premium would increase yearly to $99.32 at the age of 76.

On his other policy the level annual premium would remain fixed year after year at $45.54.

Loading.—All the premiums referred to so far have been *net premiums, i. e.,* those based on mortality payments alone.

To meet the cost of administering business, such as salaries, rents, postage, advertising, etc., a certain percentage of the net premium is added to that premium. This addition is called the *loading.* In participating policies the loading varies from 27 per cent to 33 per cent of the net premium; in non-participating policies the loading is about 8 per cent of the net premium.

Reserve.—By referring to the diagram above it will be seen that the net natural premium there given at age 55 is $18.03, and the net level premium is $45.54. The sum of the successive differences between these two quantities is the *reserve.* It is the amount paid in in early years in excess of the natural premium and is used to counter-balance the difference of later years when the level premium falls below the natural premium; or to automatically extend the policy should the payments of premiums cease. This requirement of a reserve is necessary in all level premium policies.

Gross Premium.—The gross premium is the sum of the net premium, the loading, and the reserve. It is also known as the office premium; it is the total amount per $1000 of insurance charged by the company before it will issue a policy.

From the foregoing it is seen that the basis of the method of paying the premium is as follows:

(1) The natural premium paid from year to year at an increasing rate, which rate increases in proportion to the probability of approaching death.

(2) The single premium, which is one single payment in a lump sum, this sum being the equivalent of the premiums in paragraph (1), and

(3) By the level annual premium, which is a fixed sum paid each year, the amount of the last payment being the same as the first.

(4) A modification of (3) in which, if it is desired, the policy

may become paid up completely in ten, fifteen or twenty annual payments. This is called a ten, fifteen, or twenty payment policy, and simply amounts to taking the premiums indicated in paragraph 3, above, and paying them all inside of ten, fifteen, or twenty years instead of stringing them out through life.

The question of interest is considered in each determination of a premium.

The level annual premium for a ten payment policy is naturally larger than that for a fifteen payment, and this in turn is larger than that for a twenty payment policy, which again in its turn is larger than a level annual payment continued throughout the average life. Each, however, with interest considered, is equivalent of the other and varies simply from the fact that, if we have a given sum to pay, the fewer the number of payments we make the larger they must be.

The principles involved in the foregoing methods may be crudely illustrated by Fig. 2.

Beginning at D with the age of an applicant for insurance, let each succeeding year of his expectation of life be marked off on the scale DC, and at each year erect an ordinate, which ordinate represents the cost, or premium, of the insurance for one year as calculated on the *natural* system previously explained. A line joining the ends of these premium ordinates will give a curve of natural premiums.

The area $ABCD$ between this curve and the axis will approximately represent the total amount to be paid in natural premiums. The level annual premium will then approximate the average ordinate, A_1D, such that the area A_1B_1CD = area $ABCD$.

If it is desired to pay up the policy in twenty payments instead of continuing them through life, make $DC_2 = 20$ years and find an ordinate (A_2D) such that the area $A_2B_2C_2D$ = area A_1B_1CD = $ABCD$. Then A_2D will represent approximately the value of the annual premium required to pay up the policy in twenty payments.

A similar process for ten payments will give A_3D as the annual premium; the area $A_3B_3C_3D$ being approximately equal to area $A_2B_2C_2D = A_1B_1CD = ABCD$.

The shaded area represents the reserve, which is that excess of payments in the early years of a policy which together with future premiums and interest will make up the deficiency when the level annual rate falls below the natural premiums; or which

may be used to extend the policy in case payment of premiums is stopped.

The foregoing illustration is not scientifically accurate, but crudely represents certain principles involved in the question of premiums and extended insurance.

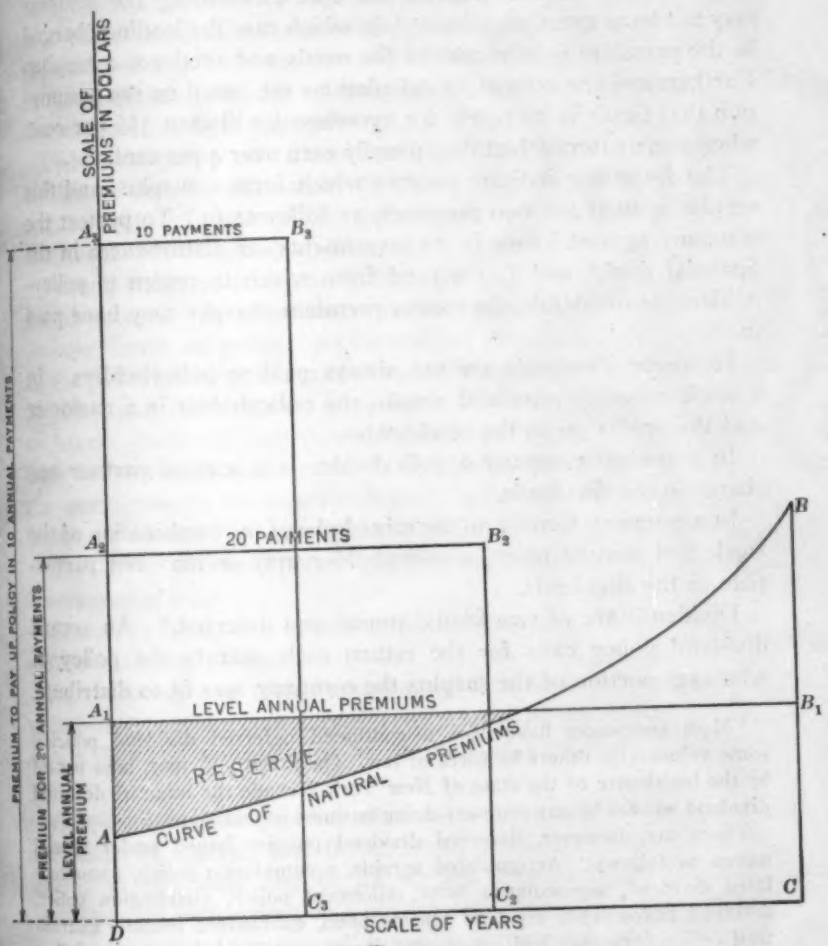

FIG. 2

Dividends, Surplus.—Every life insurance company, in order to be sure that its business balance for the year is a gain instead of a loss, must, among other things, make sure that the premiums

charged for its policies are adequate. To do this the gross premiums charged are in excess of the real needs of the situation.

In addition, while the net premiums charged are based on the average loss as determined by a mortality table, the company reduces this by not insuring at random, but by selection after medical examination. Again, the cost of running the business may not be as great as estimated, in which case the loading charged in the premium is in excess of the needs and produces a surplus. Furthermore the company's calculations are based on the assumption that funds in its hands for investment will earn 3½ per cent, when as a matter of fact they usually earn over 4 per cent.

The foregoing indicate sources which form a surplus, and this surplus is used for two purposes, as follows: (1) To protect the company against losses in its investments, or disturbances in the financial world, and (2) a fund from which to return to policyholders, as dividends, the excess premium charges they have paid in.

However, dividends are not always paid to policyholders. In a stock company pure and simple, the policyholder is a customer and the profits go to the stockholder.

In a mutual company a policyholder is a sort of partner and shares in the dividends.

In a company formed on the mixed plan, *i. e.*, combination of the stock and mutual plans, a policyholder may or may not participate in the dividends.

Dividends are of two kinds, annual and deferred.* An annual dividend policy calls for the return each year to the policy of whatever portion of the surplus the company sees fit to distribute.

*Most companies have now discontinued deferred dividend policies, some voluntarily, others by force of law. On January 1, 1907, laws passed by the legislature of the state of New York forbade the issue of deferred dividend policies by any company doing business in that state.

There are, however, deferred dividend policies issued under special names as follows: Accumulated surplus, accumulation policy, accummulated dividend, accumulation bond, allotment policy, distribution policy, dividend endowment, dividend tontine bond, guaranteed income, guaranteed option insurance and investment, investment bond, investment policy, life option, mutual investment contract, survivorship dividend.

For a list of the companies issuing these policies see the Unique Manual, 1912, published by Sampson Dawe, 501 Shawmut Ave., Boston, Mass.

Deferred dividend policies taken out before 1907 are subject to the remarks of this article.

Deferred dividend policies postpone the declaration of the divisible surplus and its distribution to some distant period, 10, 15, 20, or 25 years. If, in the meantime, the policyholder dies he loses all claim to part in this distribution. If he holds a twenty year deferred dividend policy and dies on the day before the 20 year period expires, all the excess premium he has paid and all the compound interest on them is forfeited. Neither he nor his heirs receive any benefit whatsoever for a long, continuous, additional and needless expenditure.

Unless the policy contains a legal contract explicitly guaranteeing him a definite amount as dividends, he is entitled to receive nothing but the face of his policy, and whatever amount the officials choose to apportion him.

From a policyholder's standpoint a deferred dividend policy has no advantages. It gives no more insurance protection than the cheaper forms of policy. In return for paying a quarter more, all the policyholder receives is the possibility of getting back, after 20 years, part of the excess payments. A situation in which funds as excess premiums are placed entirely at the mercy of others, with no guarantee to the owner who has no voice in the matter of the management, or return, of both principal and interest can hardly be termed "an investment."

A deferred dividend policy was the worst form of the so-called investment policies.

The same objections apply, but to a less extent, in the case of annual dividend policies.

Participating and Non-Participating Policies.—A participating policy obligates the company to return some of its surplus in dividends declared annually, or at the end of a deferred period of years.

A non-participating policy receives no dividends, and, in consideration of the fact that the company is released from the obligation of returning any of its surplus, the premium rates are lower on this policy than on a participating policy.

For the same amount of insurance protection the premium charged on a participating policy is about 25 per cent higher than that charged for a non-participating policy. The advantages and certainty of the lower premium of a non-participating policy are not generally known to the public. Some companies refuse to issue them.

For a man who to-day desires life insurance protection, the advantages of non-participating policies are worth serious study. Briefly stated in comparison, in a participating policy one pays a higher premium and at the end of each year gets a portion of his excess payments returned to him. The amount refunded is not guaranteed and, in principle, is subject to the same objections, but to a less degree, as deferred dividends.

There is almost as much opportunity for misrepresentation, as to the amount of future annual dividends on participating policies, as formerly existed with the amount of the sum total of deferred dividends. It is as difficult for participating as for non-participating companies to find safe investments, and the field in this matter is open to both. One writing on insurance says:

> A careful analysis of the premiums after deducting the annual dividends, of various companies, of policies issued in the past show that there is very little difference in the *net* result between participating and non-participating insurance. In some companies a non-participating *rate* is less, and in other companies *the result for twenty years* in participating companies is less; but speaking truthfully, I should say that if a man should take out two policies, one in the very best and most economically managed participating company, and the other in the lowest guaranteed rate in a non-participating company, the difference in the final result would hardly buy him a suit of clothes.

If this be so, the life insurance protection being the same in each case, why obligate oneself to pay the higher premium for participating insurance? A policyholder who buys a contract should know exactly what is cut out for him; he should know exactly what he has to pay, and exactly what he is to receive. This condition is not met in any policy based on estimates of future dividends, be they annual or otherwise.

Tontine Policy.—This is a dividend policy. The holder of one of these policies, who continues to pay his premiums until the policy is paid up, shares in all the excess payments made by those of his class who started with him but later dropped out and discontinued their insurance. The excess payments made by those who drop out is shared by the company and the survivors, the survivors receiving what portion the companies see fit.

Semi-Tontine Policy.—In this policy, if a man drops out after having started, he receives back some part, but not all, of his excess payments. The remainder is distributed between the survivors and the company, as the latter sees fit.

Term Policies.—A term policy is issued for a number or *term* of years, at the close of which insurance ceases. For example, a man may insure for $1000 for the term of 10 years. At the close of this period of ten years the policy becomes null and void, and the insurance ceases. Any further insurance must be taken out anew as if the term policy had never existed. Its rate is cheaper than other forms but its benefit is only temporary, and it requires a new medical examination, and a new premium at higher rates for the increased age, to obtain new insurance. Term policies are not issued over 60 years of age.

The Renewable or Convertible Term Policy.—This is a policy in which the insured is granted the right at the close of the insurance period to renew the insurance, without medical examination, for another period or term of years *at a higher premium;* or, at any time *before the last year of the term* to convert his term policy to any other form of insurance, without medical examination, by readjusting the premium. The intention of the insured to make this change and his right to do so must be expressed in the contract, and in written application to the company before the last year of the term.

For example, one officer desiring to increase his insurance during the trip of the battleship fleet around the world, took out a convertible term policy for $5000. At the close of the cruise, upon the return to the United States, this policy was converted, without medical examination, to a twenty payment life policy for $3000. The premium was about the same in each case. The advantage was the temporary increase of $2000 in insurance during the cruise, as it had been originally intended to take out only a $3000 policy. Fooling with a term policy, however, is not recommended. It is only a temporary relief which may leave one stranded, unfit physically, without insurance.

Ordinary or Whole Life Policy.—An "ordinary or whole life" policy is one in which the insured must ordinarily pay the premiums as long as he lives. In a "twenty payment life" the policyholder in twenty payments pays a sufficient sum total to insure his heirs receiving the face value of his policy in case of his death. Having paid up in twenty payments, he pays no more during life, and his heirs get the face value of the policy at his death.

The Endowment Life Insurance Policy.—This policy is one of the most expensive forms of *life insurance protection,* as the following will show:

An endowment policy without life insurance, that is a *pure, simple, endowment,* is a contract which matures at the end of a definite period. *If the policyholder dies during this period the company pays nothing,* but if the holder of this policy (a pure or simple endowment) be alive at the end of the period the company pays the amount of the endowment, *i. e.,* the face of the policy.

Pure endowment policies, as such, are not issued by life insurance companies, but are used in conjunction with term insurance to form an endowment life insurance policy.

The endowment life insurance policy is a combination of a term life insurance policy with a simple endowment policy where, in consideration of the policyholder paying *both a life insurance premium and an endowment* premium, the company agrees to pay whether he lives to the end of a period or dies within that period.

The premium on an endowment life insurance policy is found by adding together the premium for the pure, or simple, endowment and the premium for the term insurance. For example, the premium for a twenty year endowment life insurance policy, for $1000, at the age of 32, on the basis of 3 per cent reserve, using the American Experience Table of Mortality, would be found as follows:

The net single premium on a twenty-year simple or pure endowment policy is	$447.16
The net single premium on a twenty-year term life insurance policy.	140.85
The net single premium on the twenty-year endowment life insurance policy is	$588.01
The equivalent net level annual premium for single premium of $588.01 is	$41.57

If to this annual net premium of $41.57 we add 8 per cent and 25 per cent as the loading, respectively, for non-participating and participating, we shall get the level annual office rates charged for this combination of endowment and life insurance.*

The point for a would-be policyholder to note is the fact that the net single premium for the endowment part of the policy, *i. e.,* $447.16, is more than three times the cost of the life insurance part of the contract, which cost is $140.85.

At the end of the endowment period, the policyholder may elect to take $1000 cash, in which case his insurance ceases;

* On the basis of 3½% reserve the net premiums would be somewhat less than those used in illustration.

or, he may select various combinations of cash and paid up insurance, the options in some cases being contingent upon a medical certificate of good health. Granting that any option offered him for settlement may be equitable from every point of view, what is the use, if he is looking for insurance protection, of mixing it with endowments at three times the cost of the insurance carried, and with possible failure in health during the period of the policy.

Extended Insurance.—Practically all policies have on them tables of "extended insurance." This means that if the holder of the policy stops paying his premiums, the excess payments he has made in the previous years, in the reserve, may be used to keep the policy in full force for its face value, for the number of years and days given in the table of extended insurance as printed in the policy. At the end of this period the policy will ordinarily become useless. There are several variations of this use of the reserve. They are, or should be, explicitly stated in the policy.

Character of Standard Policies.—The character of standard policies may be more readily understood if they are classified and the general truths about them tabulated, as in the following table.

TABLE OF CHARACTERISTICS OF STANDARD POLICIES.

Col. 1 Basis on which premiums are to be paid	Col. 2 Kinds of insurance	Col. 3 Form of policy	Col. 4 Period of payments, maturity, dividends, endowment, etc.	Col. 5 Method of settlement
Natural premium.	Dividends annually	Ordinary life.....	10 years ..	Cash
Single premium...	Dividends deferred*	Limited payment life	15 years ..	Regular instalments
Level annual premium	Non-participating	Endowment.....	20 years ..	Bond
			25 years ..	Annuity
			30 years ..	Continuous instalments

Roughly speaking the key to this table lies in the fact that we may select any one element, or condition, in Col. 1, and combine it with any one element in Col. 2; and, in turn, this selected combination of Cols. 1 and 2 may be combined with any element in Col. 3; and, again, in turn, the selected combination of Cols. 1, 2, and 3, may be combined with any one element in Col. 4, and so on.

* See note to p. 1262 on deferred dividends.

The resulting combination is that for which a policyholder pays, and his policy is a contract in which this combination of conditions is set forth in writing.

In further illustration of the table, assume that a man has decided to apply for a policy. On what basis does he wish to pay his premiums (See Col. 1.) The natural premium, a single premium, or a level annual premium? As practically all companies use the level annual premium method as the basis of payment of premiums, we will assume that he selects that method.

The next thing for him to consider is the kind of insurance. (See Col. 2.) Does he wish a policy on which he receives dividends, or a policy on which no dividends are declared, *i. e.*, a non-participating policy? The premium on one is cheaper than the other. If a dividend policy be selected, does he wish his dividends returned to him annually or in one lump sum at the end of a stated period?* It is to be noted that these are all matters of choice for the individual who is applying for insurance.

Having settled upon his choice of methods so far, the next question for him to decide is the form of his policy. (See Col. 3.) Shall it be an ordinary life policy, *i. e.*, one on which payment of premiums continue during life, the insurance becoming due his heirs at his death? Or does he, instead of continuing to pay premiums during his entire life, prefer to pay, in a limited number of premiums, a sum total which is sufficient to pay up the cost of the policy, his heirs at his death, receiving the face of the policy as stated above? Perhaps, instead of either form he prefers an endowment form in which, if he lives a stated period he, himself, receives the face value of the policy, or if he dies within this period his heirs receive the face of the policy. Note again that these combinations of conditions are all matters of choice on the part of the applicant for the policy.

The man who selects an annual dividend policy may prefer it on the endowment form, or if he selects a non-participating policy he may prefer it on the limited payment life form.

Having settled the foregoing points, the next thing to consider is the period. (See Col. 4.)

This does not concern the man who has taken out an ordinary life policy, for in that case both the premiums and the policy continue during life. It does concern him if he takes a limited pay-

* See note to p. 1262 on deferred dividends.

ment life policy, for in this case he must, in the beginning decide whether the premiums shall cease at the end of ten, at the end of fifteen, or at the end of twenty years.

With the endowment policy, both the premium period and the endowment period must be determined. Usually the premium period and the endowment period coincide, *i. e.*, it is usual for an endowment paid up in twenty annual premiums, to mature at the end of twenty years.

If a policy is on the deferred dividend* plan there is another period to consider, the period at the end of which the dividend is to be paid, *i. e.*, the *accumulation* period.

It is usual, however, to make all periods on a policy the same. This is desirable because of simplicity, but is not essential. It has been possible, for example, to issue a fifteen payment, thirty year endowment policy with a twenty year accumulation period. In such a case the insured would have a paid up policy at the end of fifteen years; would receive a dividend at the end of twenty years; and the amount of the insurance would be paid him at the end of thirty years.

Referring again to the table (Col. 5), we come to the methods of settlement. This takes the form of a cash payment, or any combination which may be arranged with men, life, and a sum of money as elements. The general plans are indicated in the table. The variations are infinite. It is simply a case of selecting what you wish.

The Cost.—As far as premium payments are concerned, the initial cost is indicated in the table below, which gives in even dollars a fair average of standard first premiums for an applicant aged 30 years. Each company will vary somewhat from this table.

Note that in every case in this table, except cases (a) and (c), *i. e.*, the ordinary life non-participating and the twenty payment life non-participating policy, the policyholder pays for other privileges than life insurance protection, and these extra privileges are costly. Note that the life insurance protection, in each case below is exactly the same, $1000.

The premiums of all standard companies do not vary much one from the other, and are fairly represented in the table below. The final cost to the policyholder is determined by the amount of

* See note to p. 1262 on deferred dividends.

dividends returned to the policyholder, and in this matter there is great difference in companies. This itself is to my mind an argument against taking out participating or investment policies when one is looking for insurance protection alone.

In figuring the cost of his policy, the average man is liable to overlook the effect of progressive compound interest.

TABLE OF STANDARD AVERAGE PREMIUMS (AGE 30).

Form of policy	Annual premium per $1000, age 30		Remarks
	Non-participating	Participating	
(a) Ordinary life.....	$19.00	.....	Payments continue through life
(b) Ordinary life	.....	$24.00	
(c) 20-payment life.....	27.00	.....	Policy becomes paid up in 20 payments
(d) 20-payment life.....	.....	34.00	
(e) 20-year endowment ...	43.00	.....	See remarks on endowment policies
(f) 20-year endowment ...	.....	50.00	
(g) 20-year endowment Gold bond	.....	63.00	

For example, the table shows that annual premium for a twenty year, non-participating endowment policy to be $43 (age 30), and the amount he apparently pays in cash for this policy is $43 × 20 = $860.

This is not, however, a correct statement of the cost, for his $43 annually, for twenty years at 3½ per cent, compound interest, will amount to $1258.57, and it is *this* amount he has really paid for his policy.

The value of successive annual payments at progressive compound interest should be considered by every policy applicant in counting the cost of his policy, because he doesn't pay simply an annual sum of money, but that sum annually at progressive compound interest.

That this total is quite different from the other the table below will show:

Amount paid in annually	Total amount paid in in 20 yrs. neglecting interest	Amount of Col. B at various rates of progressive compound interest		
		3%	3½%	4%
A	B	C	D	E
$20.00	$400.00	$553.40	$585.20	$619.20
Difference between Col. B and amounts in C, D and E.		153.40	185.20	219.20

As a matter of interest for those who may wish to figure a bit for themselves, the following table is given:

THE SUM TO WHICH $1.00 PER ANNUM PAID AT THE BEGINNING OF EACH YEAR WILL AMOUNT AT THE END OF FROM 1 TO 20 YEARS AT DIFFERENT RATES OF COMPOUND INTEREST.

Year	3%	3½%	4%
1	$ 1.03	$ 1.03	$ 1.04
2	2.09	2.10	2.12
3	3.18	3.21	3.24
4	4.30	4.36	4.41
5	5.46	5.55	5.63
6	6.66	6.77	6.89
7	7.89	8.05	8.21
8	9.15	9.36	9.58
9	10.46	10.73	11.00
10	11.80	12.14	12.48
11	13.19	13.60	14.02
12	14.61	15.11	15.62
13	16.08	16.67	17.29
14	17.59	18.29	19.02
15	19.15	19.97	20.82
16	20.76	21.70	22.69
17	22.41	23.50	24.64
18	24.11	25.35	26.67
19	25.87	27.28	28.77
20	27.67	29.26	30.96

The Navy Mutual Aid.—The foregoing remarks upon life insurance refer entirely to life insurance issued by companies organized to issue such insurance as a business. The Navy Mutual Aid insures on different lines, granting what is known as assessment insurance, the amount of the assessment being graduated for age up to 62 years, and there becoming level or stationary.

It is difficult to compare the actual cost of this insurance with that just discussed, because the cost will vary somewhat from year to year, depending upon the number of deaths during the year.

Investigation of the results from the statement issued January 1, 1912, showed that the assessments are nearly in proportion to the risk of death as given in the American mortality tables, and that the insurance rates were somewhat cheaper for young and old members, while somewhat higher for middle aged members than the cost of the same kind of insurance, *i. e.*, annual renewable as granted by insurance companies.

The writer has not in his possession at this time accurate data for analysis as has been done in the preceding discussion, but his conclusions are favorable to the Navy Mutual Aid as part of the insurance to be carried by a service man for the following reasons:

1. The average cost is not greater than the same kind of insurance offered by insurance companies, especially as the latter have advanced their rating for age by six years.

2. The advantage in rates rest (a) with a young man when his pay is relatively small, and (b) with the older man when he retires and his pay is reduced and fixed.

3. There is not the slightest danger in swamping the society by an excess mortality in the 62-age class, because the normal increase beyond the 62-year assessment is carried by the whole membership in proportion to their assessments, thus making it relatively small when distributed over the membership at large.

In addition, it is unreasonable, and at variance with the mortality tables, to assume that the 62-age class will experience instant annihilation by death. The members in this class are of many ages, and the mortality per 1000, as given by the American table, averages approximately 4½ per cent between the ages of 62 and 67; 6 per cent between the ages of 67 and 71; about 8 per cent between 71 and 74, etc. It is not consistent with facts and figures to assume that this class could disappear at one and the same time.

4. As far as can be determined, the relative payments are equitable and fair, under the circumstances, for all ages, and, as nearly as can be determined, each member pays every year the actual cost of his insurance, based upon his risk.

5. The argument most appealing to the writer, however, is the fact that in case of death, either at home or abroad, there is a representative of the society through whom there becomes instantly available funds and aid for a distressed and perhaps stranded widow and children. Furthermore, the society secures for the widow, without cost, the pension due her.

Conclusion.—It is possible for every service man, if he will take the time so to do, to intelligently inform himself as to the fundamentals of life insurance, and know for himself what he buys and where he stands. There are in the book stores publications on every phase of the subject. The following have been found especially *readable and interesting:* "How to Buy Life Insur-

ance," by "Q. P.": Doubleday, Page & Co.; and "The Life Insurance Company," by William Alexander; D. Appleton & Co.; and for statistics, rates, and information concerning all companies which one will instantly desire upon reading the first two books, there is recommended the "Unique Manual," published by Sampson Dawe, 501 Shawmut Avenue, Boston. These books can be bought at a total cost of $5.50 for the three. The two first named should be read together.

It is not within the province of this article to recommend any one company any more than it is to recommend a bank or trust company; nor to recommend a particular form of policy, than it is to advise as to investment. Each man can easily inform himself, if he is sufficiently interested so to do.

In conclusion, attention is invited to the fact that this article is only the record of personal reading. Through correspondence with insurance acquaintances an effort has been made to have statements correct in principles. The data used is believed to be fairly representative, although the figures used will not tally exactly with those of any one particular company.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON INSPECTION DUTY AT SHIPBUILDING WORKS.

By REAR-ADMIRAL A. B. WILLITS, U. S. Navy.

Naval officers assigned to duty as inspectors of the work done by contractors in the building of our battleships and smaller units of the fleet, may not all be experts in methods of manufacture, or details of design, but, as a rule, they do know what the finished article should embody and, from their experience afloat, they are excellent critics of the plans for the various divisional requirements, from fire room to main battery.

Sea duty impresses most strongly upon the minds of such inspectors the defects in design and arrangement with which they have had to contend, and the lessons learned through having been "shipmates" with irksome or faulty conditions often bear fruit in valuable suggestions for improvement in matters pertaining to a later design which may not have been wrought out in the light of a fairly extended criticism of the old. Especially is this true in the smaller details so likely to be continued from one contract to another, unless pointed out and bettered through the experience of some inspector who has been to sea.

The writer has had quite an extended duty at shipyards both as assistant inspector of machinery, and as senior inspector, and while confident that he knows not it all, by a very large margin, he feels that there may be some members of the "Institute" who, when ordered for the first time to similar inspection duty, may find these notes and suggestions of some interest, and, if not able to cull therefrom a full meal, will at least be able to gather a moderate luncheon. But, even if this should not be true, there still remains a certain amount of satisfaction arising from having read a *soi-disant* authority and being able to say "Nothing in it." I remember hearing someone say of a relative: "He is a wonderful literary critic; perfectly wonderful! I have seen him take up a new book, open it, glance at a single page, and say 'Rot.'"

ATTITUDE OF THE INSPECTOR.

It is remarkable how much importance attaches itself to the attitude the inspector assumes toward the contractor on taking up his duties. Personality, of course, figures greatly, but even with a natural inaptitude for "supervising without directing," an inspector can make or mar his general success by his official pose. To a first time inspector there is a weight of responsibility for results which quite naturally makes him wary. He believes himself to be a detective, not only of bad workmanship, but of secret designs of the contractor to get ahead of the government in mysterious and well-designed schemes which it is his duty to lay bare and frustrate. Hence he cannot permit himself to be reasoned or cajoled into acquiescence in, or recommendation of, a proposal for even the simplest of changes without profound study of all the possible bearings it may have upon the contract or the profits of the contractor. This, of course, wears off to smoother running conditions with time and experience; yet, with some, it never does give place to either a confidence in the intention of the contractor to give a fair return for the dollars paid him, or to that greater confidence that no bad feature can possibly be "smuggled in" under a simple and practical system of supervision.

The attitude most desirable for an inspector to assume is that of a co-worker with the contractor for the purpose of securing the very best possible results. This enhances his value both to the government and contractor in a measure quite impossible to be appreciated by the wary, detective sort. When an officer assumes duty in this co-ordinating spirit he does not for a moment weaken his guardianship of the interests of his office, but distinctly adds to it by the reciprocal candor and extended privileges educed from the builders by such an attitude—and instead of being considered a hindrance to effective work, he is looked upon as a real helper, and is esteemed as a valuable assistance to progress in, and excellence of, construction.

The two poses so very opposite in effect, and yet both quite consistent with carrying out the duty fully, may be described as follows: First (and worst), the inspector contents himself with passing judgment upon all work submitted for his criticism or discovered through his vigilance, and placidly demands his "pound of flesh" as explicitly agreed to by the terms of the contract, and

described on the drawings and in the specifications. In cases of defects in material or workmanship, these are broadly condemned for slightest deviation. It is as if he were to say to the contractor, "You have engaged to build a ship in strict accordance with a detailed description of its elements and accessories, for a certain price, and I am here to see that you do it." In this spirit, and with the power or authority given the inspector, rejections are frequently made for literal and not material departures from the specifications with the result that most of the minor cases of needless condemnations stand, while, in more important cases, appeals to the Department or Bureau concerned for re-consideration, are forced to be pushed by the builders in order to save themselves from unreasonable losses.

This same spirit is also carried along in the correspondence connected with forwarding plans for approval. Drawings submitted are examined, and a list of the points of difference between the specifications and plan is made out and the whole forwarded only with the certainty of increased correspondence before approval can be secured. Delays through this cause are equally expensive to the builder, as those created through bad judgment or peremptory action in the matter of passing upon material, and indeed often much more so. This pose cannot be objected to on any legal ground. The inspector is doing his duty as he sees it but, under such conditions, an atmosphere of distrust and antagonism very soon surrounds the office in all its workings, and through this it becomes continually more difficult to see clearly; neither is it probable that the inspector will gain much voluntary assistance from the contractors under such a system, in discovering any defects that can be concealed without danger to a successful trial trip.

The second and best pose is one where the inspector's view of the situation may be expressed thus: "The contractors have entered into a contract to build a ship of best material and workmanship, and in accordance with explicit plans and specifications, and I am here to help them do it."

FIRST DUTIES OF AN INSPECTOR.

The first duty of an inspector assuming charge of any division of the work of construction of a naval vessel, is to familiarize himself with the "tools of his office," and those upon which the

contract is to be accomplished. This is not the work of an hour or a day, but must be a part of the proceedings of each day during the period of his novitiate, until he knows the principal men he has to deal with, not only by name, but also by "outline"; which means a mental sizing up of their individualities and abilities. These first impressions are sometimes quite misleading and therefore should be labelled "For test," and stored in the back part of the head and not voiced to anyone. Most frequently false impressions come through those who are the glibbest talkers and most plausible generalizers, and the inspector or contractor feels that here at least he has met one "dependable." Well—there is no use looking for trouble, and experience will never be exactly similar, but it may be put down as an axion that it is the part of wisdom in getting "acquainted," to talk as little as needs be, either regarding one's own deficiencies in the special work, or in vaunting a wide knowledge in the duties involved. The truth "will out" in ample time for all practical purposes.

Some inspectors personally prefer to conduct all intercourse with the contractors in a formal manner and by letter, whenever this is at all practicable, meeting the chief officers of the company as seldom as possible. This is supposed to lend a dignity to the inspector's office and to extract a deference from the builders which protects the best interests of the government. This is certainly a mistake and tends to delay work to a most serious degree. As it is, however, entirely in accord with the red tapeism of Navy Department work, and leads to an orderly and systematic consideration of every step, perhaps I should have said that, instead of this being a mistake, the reverse policy will be found to be an improvement and one that will greatly advance the business of the office and the completion of the vessel, and will not detract from any dignity of office that is worth possessing. Indeed it is considered most important to early pave the way for ready and agreeable personal discussions of the many points of difference constantly arising and upon which a free exchange of views is most desirable, before proceeding to letter writing, as such discussions often obviate the necessity for writing any letter at all on that particular subject or issue.

With the general manager and shop foreman the clearest understanding should be had from the start in relation to concealment of defects. It is not possible, with all the lynx-eyed assistants

ever yet allotted to the office, to prevent the concealment of some defects, some time. With all the penalties for failure to meet the contract stipulations, it is obvious that no defect that would probably militate against a best performance would for a moment be permitted by the builder to remain if they knew it, but there is another class of defects which may not prevent a perfect trial trip performance, but which would shorten the "life" of a part of the machinery, and cause the expense of removal long before a perfect casting or forging would have to be replaced, and of which these notes will treat later on. As, however, the government is paying for the "best material and workmanship," and as we are detailed for the duty of seeing that this is given us, there is no defect, however slight, and (perhaps) unimportant, that should not be instantly reported to, and passed upon by, the inspector. Therefore, the plain understanding at the beginning must be that the discharge of the immediate supervisor of any workman failing instantly to report a defect as soon as discovered, will be absolutely insisted on. Then make a case out of the first offense without recourse.

First duties include the reading of such contracts as may be in hand carefully, but the study of the specifications, so eagerly begun by many inspectors should be done piecemeal and (except for the general descriptions and those principal data which are needed for notebook and ready reference), only at such times as the particular part is brought up in submitting the detail drawing thereof for the inspector's criticism and the approval of the Bureau.

If the inspector is establishing a new office, of course the arrangement of his office force will be a primary requisite, and should follow the needs as shown under the next heading in these notes: but it is scarcely probable that such original duty will fall to the lot of many naval officers for years to come, or until this need of a fleet of the air will permit some of the middle states to go heavily into the shipbuilding trade and establish dock yards on mountain tops. Generally the office will be one already established, and in this case it is most advisable to make it one of the first duties to briefly study the scope of the work done by each of the force through personal queries, in connection with a scrutiny of the papers and methods at each desk. This will put the inspector wise to the comparative amounts of work done by each individual as well as post him, as nothing else could, in the range of

duty included in his office and its status at the time he assumes charge.

The writer would like to impress this upon the mind of the first time inspector as something which is not always done, but which it will surely pay him to do. Often an office force that has been running smoothly for some years will hold itself above the plane of criticism from a novice and will rather try to convince the inspector that he will do well to let the wheels alone and not waste time in securing explanations of the details, and that he will gradually become familiar, etc.: But what the inspector wants to know, and should know, is just what work is being done by each of his force—not for criticism at the time, but for his general information and the satisfaction resulting from knowing all the compartments of his command just as the knowledge gained by the captain of a ship, through his regular inspections, gives him a greater confidence in his control.

It is usual for an inspector to begin his duty with a note book in which he enters many memoranda, and from which he expects to derive much benefit later on. It is perhaps dangerous to decry the note-book habit, yet it is most certainly true, that it has not the value so commonly attributed to it. The only notes of actual worth (barring exact data and tabulations) are those which can be and are acted upon or filed and indexed at once, or that can be stored in the back part of the head in its proper cell. A note book full of miscellaneous memoranda, "for future reference," simply makes a fool of itself in the inaccessibility or unserviceability of its contents. Such notes are seldom explicit enough to be thoroughly intelligible after the unwritten contexts are forgotten, and as they are not indexed, the maker usually spends more time in futile search for an ancient jotting than is at all commensurate with its value.

The note book, however, has its field of usefulness for the sketches and data which should be entered systematically and in handy form, will give the inspector an accurate ready reference record of the most important features of the work in hand.

A few examples of what is considered of value for the pocket memorandum book are given in Figures 1, 2, and 3, taken from the writers loose leaf book used during his last tour of duty at a shipbuilding yard. The figures are photographic facsimiles of the original leaves, and therefore show both the size of book and the

Name Cont. #	Utah 80	Arkansas 97	McCall 78
Contract	11-24-08	9-25-09	10-5-08
" Price	$ 3946000.	$ 4625000.	$ 665000.
To be Complete	7-24-11	5-25-12	10-5-10
Keel laid	3-15-09	1-25-10	6-8-09
Launched	12-23-09	1-14-11	6-4-10
L' x B'	521 x 88	554 x 93	289 x 26
Mean Dft.	28'-6"	28'-6	8'-4
Displacement	23000.	26000.	742.
Speed Contract B	4 hrs - 20 3/4	4 hrs - 20 1/2	4 hr - 29 1/2
Speed Contract C	24 hr - 19	24 - 19	12 - 25
Speed Contract D	24 h - 12	24 - 12	10 - 16
Penalty B	$ 25000. 1/4 Kt.	$ 25000 1/4 Kt	$ 50000. per Kt.
Water per S.H.P. B	15 lbs	14.87	15.5
Water per S.H.P. C	16 1/4 -	15.77	17.
Water per S.H.P. D	26 "	25.58	27.
Penalty B	$ 10000. per 1/6	$ 10000. per 1/6	$ 1000. per 1/6
Steam pressure	185.	185.	240.
Air pressure	2 "	2 "	5 "
Weight Mchy	2060. Tons	2095. T.	272 1/2 T.
Penalty per Ton	$ 500.	$ 500.	$ 250.
Type Engines	Turb. Parsons	Turb. Parsons	Parr. Turb
" Boilers	12 - B T W	12 B I W.	4 Normand
Est. Cost Mchy	1,100,000.	1,100,000.	390 000.
No. Shafts	4	4	3
No. Rotors	8	8	5
S. H. P. Est.	30000.	35000.	12000.
R. P. M. "	330	330	775.

FIG. 1.

Illustration of note book data. Generally two pages will embody all the frequently used data.

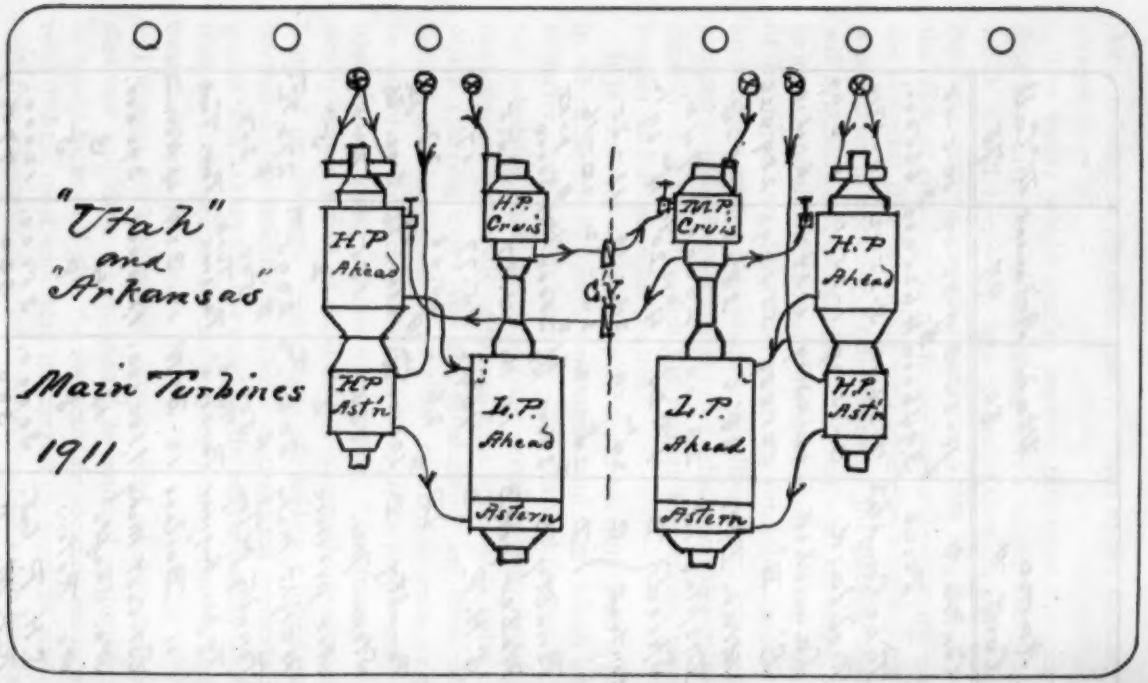

FIG. 2.

Free hand note book sketch, showing the three arrangements for using steam in battleship turbines. 1st, to H. P. ahead and L. P. ahead direct; 2d, to M. P. cruising, to H. P. ahead and to L. P. ahead; 3d, to H. P. cruising, to M. P. cruising to H. P. ahead and to L. P. ahead. Pipe lines should be in red ink preferably.

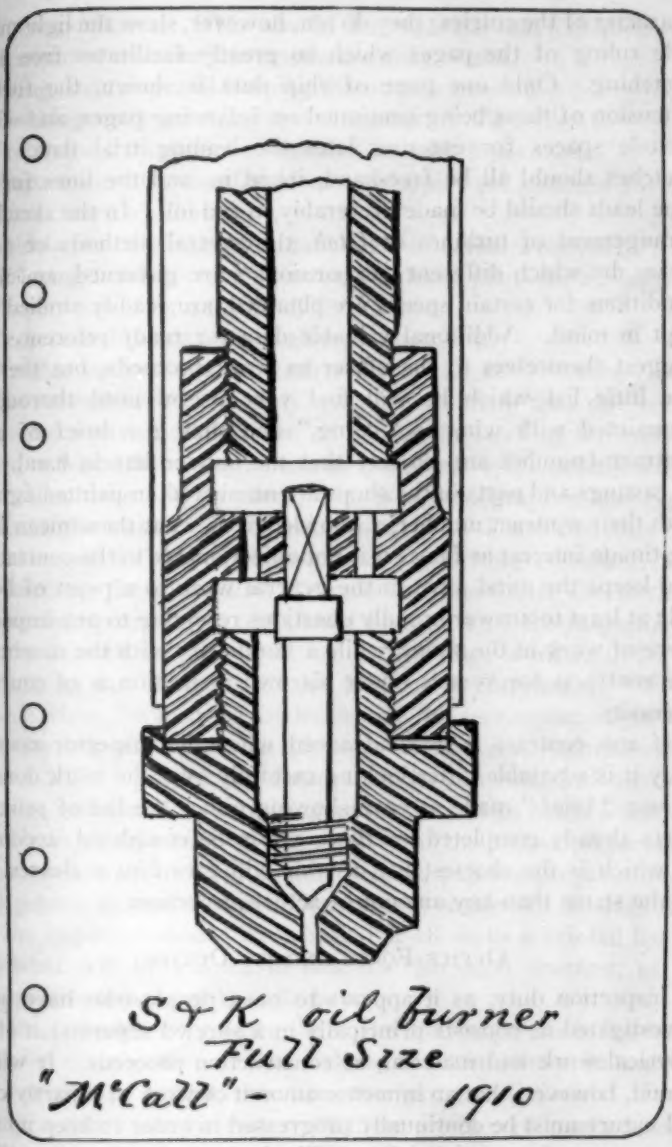

FIG. 3.

Free hand note book sketch illustrating character of work recommended for novel features desirable to make familiar. This burner was used on McCall & Burrows under the inspection of the writer. Use no dimension figures in full size sketches.

H. P. ahead and L. P. ahead direct; 2d, to M. P. cruising, to H. P. ahead and to L. P. ahead; 3d, to H. P. cruising, to M. P. cruising to H. P. ahead and to L. P. ahead. Pipe lines should be in red ink preferably.

character of the entries; they do not, however, show the light quadrille ruling of the pages which so greatly facilitates free hand sketching. Only one page of ship data is shown, the further extension of these being continued on following pages, and which include spaces for entering later the leading trial data. The sketches should all be free-hand, inked in, and the lines for the pipe leads should be made preferably in red ink. In the sketch of arrangement of turbines of *Utah*, the several methods of using steam, by which different "expansions" are governed, and fixed conditions for certain speeds are obtained, are readily studied and kept in mind. Additional valuable data for ready reference will suggest themselves to the officer as work proceeds, but there is one little list which he will find very useful until thoroughly acquainted with what is "doing," and that is a brief of each contract (number and object) that the builder has in hand. As all castings and parts in the shops are numbered, in painted figures, with their contract number, a knowledge of what these mean is of legitimate interest as far as it is not objectionable to the contractor, and keeps the mind alive to the general work to a point of being able at least to answer broadly questions referring to any imposing piece of work in the shops, while a familiarity with the number of the contracts for vessels under his own inspection is of course a necessity.

If any contract is well advanced when the inspector assumes duty it is advisable, after looking carefully over the work done, to have a "brief" made at once showing either the list of principal parts already completed, or those yet to be completed, according to which is the shortest list, as this will give him a clearer idea of the status than any amount of actual inspection.

OFFICE FORCE AND ITS DUTIES.

Inspection duty, as it appears to most people who have never investigated it, consists principally in a shrewd supervision of the physical work and material, as construction proceeds. It will be found, however, that an immense amount of work of a partly clerical nature must be continually progressed in order to keep up with the game and not cause delays. The inspector's office must therefore be provided with proper "tools and facilities" if the results of his work are to be worth while. This office work covers the following duties:

Correspondence. This should be separate and complete for each contract whether the vessels are alike or not.

Filing, indexing and keeping attendance records.

Checking up detail drawings and indexing file copies.

Preparation of papers in connection with "payments."

Preparation of estimates of costs of approved changes for use by the "Board of Changes."

Calculation of weights and tabulation of actual weights.

Checking finished tracings and the reduced plans for booklets.

Preparation of data for Trial Trip Board.

Reports and tabulations of all tests made, and

Writing up journals for each vessel under construction.

Correspondence—Clerical Work. Where more than one vessel is under construction (except, of course, in cases of the smaller types, or when there may be two or more destroyers exactly alike) there should be a chief clerk, who is a stenographer and typewriter, and an assistant who is a typewriter. These two men can attend to all the correspondence and typewriting necessary, and can keep up the index and file records properly, if the work is systematically arranged. It should be a duty of the inspector to interest himself in the regulating of the office work in order to prevent, as far as possible, the frequent recurrence of "Field Days," when the disorder of haste and the recriminations of the tardy or lax may make an undesirable and really unnecessary exhibit. This proper regulating can be accomplished in only one way, and that is by requiring an advance to be made wherever possible in all data collection necessary for the proper preparation of papers known to be ultimately needed, and the preparation of such papers as soon as the information is obtained. To facilitate this the inspector should have posted at all desks a briefed list of just what will be wanted in this line for each contract, as an obvious discourager of the idle hour.

In an extended experience the writer has found the office force of an inspector's office no less inclined to procrastinate in matters not immediately urgent, than are other groups of mortals. True, when the time came for rush work there was a very loyal response to the call, and they performed that miracle, so common to us all, of "just getting the last paper completed in the very last minute" possible to allow. Perhaps this variety is not a bad thing, and that it does the mind good to be "put to it" once in a while, but it

is not in accord with the rules of efficiency, and we must keep everything up-to-date in office work if we would get best results and appear to best advantage. The rush times will come in spite of all that, but they will be legitimate and not bastard.

Especially there should never be permitted any preventable procrastination in filing and indexing papers and correspondence. This putting off until a leisure day, is wrong in principle and detrimental to dispatch of work, and the effect of having to await a search through several piles of documents, or a drawer full of mixed letters, for a paper urgently needed is, at least, not soothing. If the inspector will insist on completing the filing, each morning, of all accumulations of the preceding day before general work is taken up, he will be surprised at the ease with which this is accomplished, and pleased with the knowledge of being able to secure at once any record he may want that has passed through his hands or office. In this connection it is well to remember that often papers will come in for forwarding, of which it may not be deemed important to keep more than a copy of his endorsement. He should not lightly judge of this, but should at least dictate a comprehensive extract (often better, because briefer, than the original) and file with the forwarding endorsement.

The periods of greatest activity on the part of the actual clerical force of the office is when a trial trip approaches, or when two or more requests for "payments" are suddenly sent in. As a rule the chief clerk keeps in touch with the contractor's intention regarding applications for payments, and can begin getting up his papers fairly in advance, but it is not always possible to prevent rush work at these times. The contract price is paid the contractors generally in fifty separate payments, whenever the material bought and received and the work done amounts to a sufficient sum. On the contractor's part the vessel is kept insured to its value as advanced, and reserve payments are held at the end until acceptance is final.

The papers forwarded to the Department with each application for payment appear to be excessive but perhaps are really not so. With a letter of transmittal the inspector of machinery, for instance, must include the letter of the contractor advising that they have made application for the particular payment; an itemized statement from the contractors (under the principal divisions of the work) of total amount of cost of labor, and material furnished

to date of application which they desire to include. A certificate (or copy) from the sub-contractors for boilers, showing how much they have received from the contractors on account of work done; an itemized statement from the inspector under the principal divisions of the work, showing condition of work in percentages accomplished; a formal estimate of total weight and cost of material, and cost of labor for work done to date and for material on hand yet to be incorporated; a letter showing amount of material received from the makers of the boilers; a public bill signed by inspectors of hull and machinery covering the payment asked for; affidavit from the treasurer of the shipbuilding company relative to the absence of liens against the vessel; and affidavits relative to the work having been done under the eight-hour law.

The time for requesting payments can generally be managed so as to utilize the regular monthly reports showing percentage of work accomplished, and thus obviating separate calculations for an intermediate report of this kind.

The papers neccessary to be prepared in connection with the trial trip of a battleship indicate in a greater measure the amount of upkeep work in data collecting that is referred to above as not to be put off any longer than is compulsory from lack of available information. I quote the list of papers for the *Arkansas* as a good example, and believe simply from the consideration of these items one can gain quite a comprehensive idea of what inspection duty covers.

The list is as follows:

PRELIMINARY OFFICIAL TRIALS; INSPECTOR OF MACHINERY SUBMITS CERTIFICATES, REPORTS AND OTHER PAPERS TO THE PRESIDENT OF THE TRIAL BOARD.

Certificate of the exact weight of machinery under cognizance of the Bureau of Steam Engineering, in accordance with the contract for the above-mentioned vessel.

Certificate that the machinery is strong and well built.

Certificate that the machinery is complete in accordance with the contract.

Certificate of the calibration of feed water measuring tanks.

Certificate regarding quantity of bagged coal, and weighing of same.

Certificate of tests of ash hoist engines and gear.

Certificate of tests of engine room signal gongs.

Itemized list of unfinished work under cognizance of the Bureau of Steam Engineering.

Itemized list of work under cognizance of the Bureau of Steam Engineering (Electrical) to be completed by the government after delivery of the vessels.

Recommendations and suggestions to the Trial Board regarding alterations and additions.

Table of tests of steam and vacuum gauges.

Reports of tests of auxilaries, as follows:

Horse-power curves of auxiliaries.

Test of ice machines and cold storage plant.

Test of workshop tools.

Test of generating plant (48-hour).

Quantity of fuel oil on board, and method of measuring.

Calibration curve of Gary-Cummings Torsion Meters, and affidavit regarding correctness of same.

Calibration of main engine shafting, and shaft horse-power constants.

Propeller measurements.

Synopsis of machinery and hull data, Bureau of Steam Engineering Form No. 77.

Coal bunker measurement calculations, and capacity curves.

Certificate of boiler safety valve setting.

Test of evaporator and distiller plant.

The Detailed Drawings and How Handled.—The Department's contract plans upon which the estimates for bids are made do not exhibit the details. Outline and general arrangements are shown, to be read in connection with the specification describing material and sizes of main parts, but making the detailed drawings for each part is the business of the contractor, and it is in working out these details that the skill, experience, and engineering ability of the contractor's designing force is brought into the lime light, and makes for superior or inferior results. The tendency naturally is towards conservatism, and it will be found that radical departures from known "good enough" designs, that are acceptable to the government, are few and far between, simply because of the greater safety in play of that kind. It is up to the contractor to realize such results as will avoid the penalties noted in the contract for defect and default, and it is for this reason, and for lack of funds for large experimental work that we are slow to initiate, generally following the more venturesome and enterprising engineering of the "other side" instead of leading.

Hence the majority of detailed drawings of machinery submitted by a contractor for approval are similar in design to approved drawings for former vessels, modified only in dimensions. The detail drawings, as completed, are sent to the inspector, each

accompanied by a letter in duplicate, in which should be stated all the departures from the specifications embodied in the plan. This, however, is not always done, and while it is of great advantage to have the drawings presented with this information, it does not relieve the inspector from the responsibility of the completeness of the list, and which compels him to have a most careful scrutiny made by the draftsman in charge of checking up these details. It is at these times that the inspector particularly studies the specifications and it is of the highest importance that he has the assistance of a very superior marine engine and boiler draftsman (for machinery office), and an excellent electrical draftsman for the electrical equipment, to make these careful studies and bring to him a synopsis of discrepancies found that are not simple mistakes of the contractor's draftsman, readily corrected. The drawings could go forward formally, simply calling attention to departures from the specifications and recommending approval or disapproval, and putting the detail up to the Bureau for further study; but a preferable method of handling this work can best be shown through the following slightly digressive paragraphs.

The inspector will find that as time goes on inquiries will be made of him by the contractors, by letter, as to why certain drawings, submitted weeks before, are held up, and he will perhaps find that these either have only just been forwarded to the Bureau or are still piled up on the waiting list. Sometimes, of course (although seldom), the delay is at the Bureau. Such inquiries are annoying and compel definite reply or explanation, and no inspector cares to say it is because he is short handed or over-crowded if he can avoid it, because with proper distribution of work he may not be. The facts will usually put the real blame on the contractor for sending in drawings in bunches instead of in a fairly continuous manner, and putting on an overload for which the office is not rated. The real cause, however, is lack of co-ordination between the inspector and builder in the designing work.

If the inspector shows a keen interest in design and is tactful, he can make himself *persona grata* to the designing department of the contractor and, by avoiding all supercilious criticisms, can gain a foreknowledge of what is to be submitted that will be most helpful in expediting the final approval. In fact it would be of greatest advantage if the chief draftsman of the inspector's office could always go over with the chief draftsman of the contractor

all new designs in the pencil, before tracings are made and prints struck off, and note or correct all discrepancies at this time. To all novel features the inspector's personal attention could then be called and a brief discussion secured, while if the inspector, through his personal experience has suggestions of value to offer at this time in direction of overcoming some inconvenience or difficulty in actual service, he may be sure of an intelligent hearing and a cheerful willingness to change if it is really an obvious improvement. There can be no question of the mutual advantages of this co-ordination, in getting before the Bureau drawings with a clear and full criticism, and with intelligent and reasonable recommendations, and not simply present the data and let the Bureau hoe its own row in deciding, or have the contractors personally discuss with the Bureau, in improving the inspector's value as a just critic.

The standard size of drawings for machinery (27 x 40 inches or multiples of that size) permits drawing in arrangements and details to a good working scale and allows most of the details to appear on the same sheet as the assembled part shown. The titles should be clear and in large type in lower right-hand corner, the drawing number in particular being made in larger and more prominent figures than the balance of title subject matter. A good system for numbering is to give every contract a number and incorporate that number as a prefix to the drawing number. Should there be many parts to a contract a composite drawing number is most useful, *e. g.*, drawing number 100-500-5 would mean contract 100, section or part 500, sheet of that part 5.

This facilitates tracing work in the shops and in the records of the drawing rooms, general offices and accounting department. The scale should always be sufficiently large to enable all dimensions to be easily read, and dimensions should not be unnecessarily repeated. This mistake in putting all possible dimensions on each view of a part has led to many shop troubles and losses through using the wrong dimension, for, in checking up drawings, it is frequently found that one dimension is not correct, and in changing this the draftsman sometimes overlooks the correction of the same dimension in another view, and the uncorrected dimension is the one which the workman, through some blind fatality, will be sure to use.

Finished drawings for filing and permanent record must be made on the glazed side of tracing cloth and must be veritable tracings in good India ink, of the original drawing with all connections or approved changes shown thereon. The original drawing is of course in pencil, and is generally traced off for the purpose of securing blue prints to submit for approval and for shop use, but a careful and skilful draftsman can design in pencil on the dull side of tracing cloth and ink in the original for printing purposes, or in cases of sketch work, secure blue prints from the pencil drawing and save much time thereby.

Cross hatching for "sections" is far preferable to coloring, as it shows up so postively on blue prints and renders them much easier to read in the shops. It is our custom to resort to coloring very seldom, although abroad the opposite is the case, and coloring is applied to a great majority of drawings and prints, quickly, and by a trained force of young people at low wages.

Each drawing is required to have shown upon it a complete "list of parts," and each separate piece of a detail drawing must have a "piece number" clearly printed and "tied" to it by reference line. There is no uniformity in the practice of the several shipbuilding stablishments relative to the data and arrangement of this list of parts, nor is the inclusion of calculated weights adopted by any of them. In reference to the work of making out weight sheets noted under the next following section, it will be readily seen that such a column, if filled in on all detail drawings submitted, would be found most useful as a comparative check on the work and, besides this, the ever present weight record of each part of the machinery, on the drawing of that part, would most obviously be of great and frequent value to the engineer officer of the vessel, and to any one "reading" the drawing for full information. Some shipbuilders use the term "mark" for "piece number," and some put in column for weight with nothing in it. A model scheme for this list of parts would be headed "List of Parts for One Complete Ship," and would have the full data in columns under the following headings and sequence: Piece No., Name of Part, Number Required, Material, Pattern or Die No., Est. Weight, and a head column for Remarks. All other data, found useful only to the builder in his work, should be excluded from the detail prints and finished drawings furnished the government.

In checking up drawings (blue prints) with specifications and record of approved changes, it is a good plan to use a yellow pencil for marking errors or questionable points, and a red pencil for checking off the correct points.

The following scales should be used in preparing plans: ⅜-inch and ½-inch for general arrangements of piping showing details; ½-inch and ¼-inch for general arrangements of piping showing outline only; 1-inch and 1½-inch for assembly arrangements of engines and machinery; not less than 1½-inch for details of engine and machinery parts, 3-inch being more generally used than any other. All lettering, figuring and dimension lines should be clear and distinct, a square hand being preferable on account of being more easily read. No colored inks should be used. Where possible, dimensions should be given outside the figure, especially if the figure is in section. When the drawing is not to scale the dimension should be underscored by a heavy line so that the discrepancy is readily noted.

An office record print should always be retained of each plan submitted, and upon this should be recorded date of receipt from contractors or outside party, date of return to same. Letter number, and date of, and office file number. This does not entail much additional work if a rubber stamp is used for this date with properly arranged headings, while the great convenience of the record and time saved in searching files thereafter is obvious.

Changes.—It will be found that the one impossible thing to do is to have a contract carried out exactly as originally specified. With the constant advance in the mechanical arts, and the improvements that are continually being devised by those whose minds are devoted to such work, there are always some features of the specification for a warship which, between the time of their compilation and that of their practical application, develop "wrinkles" or some other signs of approaching senility, or else are shown to be unnecessarily complicated. In such cases changes are prepared either by the government or builders tending to improve matters, and each of these changes is treated separately and in detail as effecting the cost of the work. As soon as the Department approves of a change it directs that the matter of its cost be referred to the Board of Changes, which is a conference of somewhat permanent character, meeting at such times as the accumulation of pending subjects demands, and deciding upon the amount to be

deducted from or added to the contract price for each change approved.

Before this board acts upon any item the inspector has prepared a detailed estimate of the cost of the new arrangement or modification, as well as the probable cost if the work was done as originally specified, and this preparation requires good judgment, mechanical experience and a knowledge of current labor and material costs. It is a part of the duty of the chief draftsman of the inspector's office to work out these estimates, independent of the calculation of the contractor, as, although a stated sum has been given by the latter in the proposing or accepting letters, the legal adjustment is the answer of the board, and the proper estimate becomes a matter of serious consequence as regards the final cost of the vessel.

In deciding the final amount of increased or decreased cost for any change, the board listens to the argument of the contractor's representative and his statement in detail, as well as going over carefully the office estimates, and it is therefore necessary that these estimates be presented clearly and logically; and in this work the inspector will soon realize the value of his chief draftsman.

Sometimes it happens that, while the cost of an approved change is less than that of the originally specified work, the resultant modification is of such distinct benefit to the vessel and the government as to entirely offset the deduction, and it is the duty of the inspector to make such recommendations to the Department or Bureau concerned as will bring the fairest treatment to the contractors possible, under all the circumstances of the building. This effect on the value of the completed ship is not always considered as broadly as it should be, and while there is danger in any loose method of dealing with changes, the reasons for, and the final effect upon, efficiency should count in special alterations, with decided favoring of the contractors in cases of doubt. All changes are in line of improvement, and where a contract is made to build a vessel according to a general design and a detailed specification, and the contractor can greatly improve upon that design in some detail and show a better result than was called for, either by a simplification or modification, it gives him little encouragement in such effort if a corresponding reduction is made in the amount paid him, due to an estimated reduced cost to him in the physical incorporation of the change. One may imagine such cases arising, as the writer has

realized them, and while most of the changes are minor or do not come in this class at all, it would appear that in the class referred to an estimate on the value of this new design itself could well be considered by the board.

Weights.—When one considers the vast number of elements comprising a modern battleship, and realizes even in a modest degree the calculations necessary to produce such a vessel of a displacement closely predetermined, and a speed within a fraction of a knot of that stipulated, he can, while marveling at the accuracy of the designs and the wonderfulness of the results, appreciate the importance of estimated weights for every part and their approximate coincidence with the actual. No such results as are now possible could have been approached without a vast collection of correct data, and their arrangement and tabulation in groups so as to permit handling the many details in "blocks" as it were, and estimating the weight of groups from a knowledge of their components. In machinery where the varieties of appurtenances are manifold and where the main engines themselves have changed so completely during the past decade, it is most essential that each contract shall contribute its share of accurate information regarding relative weight and power so that increased facility shall be given to the work of designing new vessels to meet desired requirements.

The estimates for weight of machinery of the several types are made upon previous results and their indications, and are approximately as follows: Reciprocating machinery for battleships and heavy vessels, with the B. & W. boilers, 10½ horsepower per ton of machinery; turbine machinery for same class, 15 horsepower per ton of machinery, while with Express type of boilers and turbine machinery for destroyers it is estimated at 25 horsepower per ton. To preserve a proper regard for the importance of this feature, there is attached to each contract a penalty for overweight of machinery, the upper limit being stipulated clearly in the contract, so that builders are mulcted $500 per ton of excess of such weight for battleships, and half of that for destroyers, and the actual weight of every piece entering into the construction is ascertained most carefully before it is put in place.

It is the inspector's duty to secure the record of the weights as the parts are prepared, and for this purpose he must not only have a weight clerk present at the scales, but must check up from the

drawings by estimating the weights of all the details of parts that are built by contractors, and not bought or installed in an assembled unit susceptible of being weighed and tabulated as such a separate item. These are, however, listed so as not to overlook any piece in obtaining the weights from the records, yet even with all these precautions some remarkable instances of omission have occurred, such as leaving out entirely the weight of one smoke pipe—the error being caught by comparing weights with those of a sister ship building at another ship yard.

A good engine and boiler draftsman is needed for these calculations and the proper tabulation of weights in groups, and his exactness and care will save a world of trouble such as comes when the reported weights on board do not at all account for the draft. The groups referred to for these weights are:

I. Main engines, casings, etc.
II. Shafting and couplings.
III. Line and propeller shaft bearings.
VI. Main condensers.
VII. Main air and circulating pumps.
VIII. Propellers.
IX. Boilers.
XI. Uptakes, smoke pipes and guys.
XII. Steam and exhaust pipes and valves.
XIII. Suction and discharge pipes and valves.
XIV. Lagging and clothing.
XV. Floorings, gratings, etc.
XVI. Auxiliaries.
XVII. Fittings and gear.
XVIII. Water.
XIX. Stores, tools and spares carried on board.
XX. Miscellaneous machinery.
XXII. Connections to other miscellaneous.

It will be found that the weights added to or subtracted from the contract weight through approved changes sometimes even up quite fairly. As an illustration there were 30 approved changes in the machinery of the *Arkansas,* which involved an increase of 60,830 pounds, and a decrease of 47,775 pounds, leaving but 13,055 pounds, or 5.825 tons to add to the 2095 tons specified in the contract, through this cause.

Finished Tracings.—Where there are several contracts active under the inspector, it will be necessary to have another draftsman to check up the finished drawings which the contractor must furnish at the end of each contract. These sets of carefully made tracings must be of standard size and embody every change approved or made, and otherwise accurately show the object as actually built, and when one realizes that there are between 1200 and 1300 plans for a modern battleship (hull, machinery, ordnance, and equipment), he will understand the magnitude of this work. In making these tracings the contractors, knowing that the inspector must check them up, often fails to make a proper effort to discover all mistakes or omissions at first, and the inspector will do well to insist on care in this particular, to avoid delay and the return of tracings to them for correction. From these finished tracings all the blue prints are made for issue to the vessel and to the various yards, and mistakes, if allowed to remain, would possibly be productive of serious consequences.

Booklets.—It is customary now to require a set of reduced size drawings of general arrangements, pipe plans and such of the details as are most liable to be in frequent use, and have them lithographed and supplied by the contractors in flexible cover booklets for handy reference on board ship. These must be also carefully checked up as they are not always photographic reductions of finished tracings, but are made specially to clearly show certain distinctive features or plans on each sheet.

SHIP AND SHOP INSPECTION.

The details of office procedure, while necessary to the work, do not appear to the future inspector to be as important a part of the duty as does the actual physical inspection of the material and workmanship entering into the construction of the vessels under his charge. In this latter work his responsibilities seem entirely practical, and his guardianship of the public interests here has its final exercise with no possible recall of decisions. Let us, therefore, define as closely as possible the proper lines upon which he can proceed with safety, and at the same time see how he is assisted in the prevention of unsatisfactory results. Anyone, however, expecting to find in these notes a clear and definite guide through all the "maze" will be disappointed, because "there ain't no such animal."

While the good inspector becomes so through experience, a study of the requirements, and a common sense application of these to the work in hand, assurance can be given the inexperienced which should be of comfort, and that is that if the inspector will bear constantly in mind that nothing but the very best material and workmanship will satisfy the contract, he will be saved many a period of uncertainty; and possibly also of regret and anxiety at having accepted something doubtful through a too lenient consideration of the losses of the builders attendant upon the condemnation of an expensive part. He must remember that nothing has done so much towards bringing material and shop methods up to their present excellence as has the framing of high grade specifications and compelling the contractors to live up to them through having the work supervised by officers; men devoted to the interests of the government and beyond suspicion of corruption or of venal laxity. These inspectors, by their consistent rejection of inferior or defective material or workmanship, have made necessary on the part of designers, manufacturers of material, and of shop supervisors, a continuous study of the possibilities in improvements which has resulted in production of such uniform grades of material which, at the time of the writer's first duty at a ship yard, would have been considered absolutely impracticable; and has also revolutionized design and workmanship in marine engineering construction. Therefore, it will be seen that while rigid inspection is, at times, mercilessly cruel to the immediate gain of the builders, it nevertheless ultimately works to their highest advantage, and adds each year to their ability to produce better and more perfect results.

As it is quite inconceivable that perfection in either material or workmanship will be ever secured, the nearest practical approach to it, consistent with requirements of the service demanded of the parts, is all that should be aimed at. This does not mean any deviation from the specifications that are intentional, no matter how much lee-way might be allowed for an accidental discrepancy. In the latter cases, a full and careful consideration should be given to the particulars of the fault or defect in relation to the effect it will have on the service of that piece, and when it is found obviously inconsequential, there should be no question of passing it; exactly as would be the case were the inspector paying for the vessel himself. It is a pertinent query to put to one's self in these cases, "Would I take it if I were buying it for myself."

If the consequences of using the parts are doubtful at all, the same directness should accompany its rejection, so as to permit the ordering another part at the earliest moment. There should be no doubts accompanying acceptance. If the matter is one of serious difference of opinion and the contractors desire to go beyond the inspector, it should be with his full written statement to the Bureau of his reasons for rejection, and fully shift the responsibility of overruling him to the Bureau, or whoever it is delegated to. Sometimes hardships are no doubt inflicted upon the contractor by rejecting what would be absolutely as good as a perfect part, but the moment laxity is shown in the matter of allowing "good enough" to equal excellent, when excellent has been stipulated, the efforts to produce excellent will be a little bit relaxed also, and a *precedent* in official action of this kind will have been established that will have a most persistent way of embarrassing future decisions.

Decisions should not be delayed a moment longer than it takes to get at the facts, or the positive existence of a reasonable doubt. It is money saved to the contractor to have decisions made promptly, one way or the other, and they justly appreciate a man who will not dilly-dally over a defect, nor take questions of acceptance home to think over and prepare a decision for next week. This must not be construed with advocating hasty or arbitrary action. If the inspector does not feel qualified to personally declare upon the fitness of a part, he should consult his assistants of more experience in the particular work, and if he does feel himself so qualified he should still consult his assistants so as to avoid overlooking some pertinent reasons for or against, which may may not have occurred to him. He should always have a reason and state it, but he should not argue over a fact.

All parts purchased from sub-contractors in a finished state, such as boilers, tubes, blowers, pumps, in machines, etc., and all castings and forgings made by sub-contractors for final machining by the contractor, are inspected by other officers detailed for outside material inspection, and in this degree the shipyard inspector is primarily assisted in a large field. He accepts these parts subject to final tests on board ship or to rejection for defects developed in machining.

As the inspector cannot personally be in the shops or on ship board more than an hour or two a day, he must have his representatives, special mechanics skilled in machine work, always

on the job. One at least should be in the shops and one on each large ship as soon as installation is begun, and the duty of these men is to keep the inspector daily posted as to defects, or of important work approaching in line of tests which he would prefer to witness himself.

In the larger items of shop work, and those in which accuracy and excellence of work and material directly affect the results of the trial trip, the contractor's interests are paramount, and there will be found little to criticize that will not be discovered and made good on the builder's own initiative. Clearances, journals and bearings, balancing of shafting and rotors, and of propellers, and making tight joints, all must be cared for in the best manner to bring about a satisfactory performance in engine operation and in water consumption.

The largest field for inquisitive inspection is that of castings, especially of iron or steel, and in this the inspector will find it necessary to remind himself of the guiding principle very often—"Only the *best* material and workmanship." In large iron castings, as of rotor casings or cylinders, there is need of assuring oneself of having the proper thickness of metal in the walls, with proper allowance for machining, and especially must the flanges measure fully up to the design after carefully noting the drop which the boring of a rotor casing will bring about, and upon which the final thickness of flanges will depend. Far better have them too thick than even a sixteenth thinner than called for. In parts of such importance and costs, there is no economy in allowing machining to proceed when positive indications are that the part will not measure up or will be a little short of dimensions when finished. Call it off at once, and if it appears to be within a fair margin of safety, refer the matter to the designing bureau immediately with exact figures, and do not assume any authority to accept short measure yourself, at least in flanges or in the steel castings for high pressure parts. It is usually under the test pressure that defects are found. One here must look closely for cracks and at once reject a cracked valve body no matter what metal it is made of. Sometimes a slightly porous condition will show up under the very severe hydraulic pressure put upon these bodies and yet not actually indicate a spongy spot in a bad sense. Slight caulking or peening will sometimes fully stop this acceptably, but spongy spots can be discovered by the peen hammer also, and an expert will readily show up the

difference. After machining, steam valves are tested under steam pressure, also to see if distortion from expansion prevents the valve from seating tightly, and in cases of the "double poppet" throttle valves of Destroyers, the greatest difficulty was experienced in this direction. It is interesting to study the designs of the larger steam valves and see the difficulties in the way of getting a "cold and hot tight" valve.

Electric welding may be allowed by the Bureau when the replacement is a serious expense or a cause of great delay to the vessel. This has been done with very satisfactory results in numberless cases abroad and at home, but in contract work it should not be permitted without a six months' guarantee after delivery of vessel.

The special mechanics must look closely after test numbers and inspector's stamps on material from outside sub-contractors, and should not permit removal of identification stamp until transferred to another part of the piece. Parts as finished should be weighed, stamped and recorded for final computation of weight sheets. Spare parts must be inspected, checked, boxed and boxes clearly marked with note of contents.

The witnessing and record of shaft calibration under torque must be carefully carried out, as the great value of the data is obvious in trial results.

Ship Inspection.—In installing machinery the general layout, as designed, generally will be followed very closely in the main elements, but in the case of the adjuncts and accessories thereto, much latitude is reserved and changes in location of auxiliaries or in run of piping are not only frequent but, for best results, must be made by personal observation of the compartments, and a practical sizing up of the several possible arrangements by temporary placements. The guide-word for this part of the work is *accessibility*—always *accessibility*. The inspector must be keenly alive to the fact that overhaul and repair work must often be done at sea, and in a hurry, and he must not permit a valve, pipe joint, cylinder, steam chest cover, or any other removable part to be located where its "undoing" will be the undoing of the worker. It is easy to prevent such faults in the original installation, but so difficult to correct them afterwards, that the writer most earnestly urges that the query be ever kept in mind "Are the removable parts readily accessible?" and then work to secure the very best arrangement it is possible to obtain.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVY YARDS AS MANUFACTURING ESTABLISHMENTS, AND THE COST OF MANUFACTURED ARTICLES.

By ASST. NAVAL CONSTRUCTOR C. A. HARRINGTON, U. S. Navy.

During the past few years the importance of navy yards as manufacturing plants has been brought home to some private concerns in the loss of contracts on account of the fact that a saving could be effected by manufacturing the article in certain yards at less cost than the same could be purchased. Careful scrutiny of cost returns to the bureaus, and investigation of the cost of manufacturing standard articles of equipage at the different yards has resulted in the designation of certain yards as manufacturing headquarters.

Every officer in the service knows, in a general way, that the New York yard has a capacity for manufacturing anything in the shipbuilding line from a rivet to a completed 26,000-ton ship. In addition, however, to being the designated navy yard for the manufacture of *Dreadnaughts*, the New York yard is also the manufacturing headquarters for a number of other articles of equipage. The following table, which shows the yards at which various standard articles are manufactured, may be of interest:

New York	Boston	Philadelphia	Norfolk	Portsmouth	Puget Sound	Mare Island
Ladder treads	Cot frames	Chests, inflammable liquids	Galley tubs	Clinical chart holders	Straps for hinged berths	Motor dories
Meat blocks	Motor dories	Mess tables and benches	Paint, torpedo boat, green	Invalid's food trays	Refrigerators	Paint, torpedo boat, green
Cutting tables	Straps for hinged berths	Machine cutting tools	Coaling bags	Spit cup holders	Chests for inflammable medical stores	Racing cutters
Racing cutters	Chains, ground	Refrigerators	Paint drums	Tumbler holders	Cleaning and painting stages	Boat cloths
Boat cloths	Chains, hang	Boat hooks	Signal-flag chests	Boat spars	Speed cones	Canvas cots
Coal trucks	Chain punches	Cleaning and painting stages	Paint, ship's bottom	Camp chairs	Ditty boxes	Covers, baize, for chronometer box

New York	Boston	Philadelphia	Norfolk	Portsmouth	Puget Sound	Mare Island
Coaling bags	Canvas cots	Chests for inflammable medical stores	Paint, for striping	Camp stools		Curtains, airport, door, etc.
Covers, baize, for chronometer box	Devil's claws	Wood fenders	Hammocks	Cooperage		Flags
Curtains, airport, door, etc.	Hammock bags	Anchor buoys	Ditty boxes	Franklin life buoys and spare parts		Table covers
Flags	Windsail bags		Scuttle butts for destroyers	Vegetable lockers		Signal-flag chests
Table covers	Bag bags			Squilgees		Vegetable lockers
Boat chests	Hawsers, rope, cordage			Squilgee handles		Mattresses
Mattresses	Hooks, chain			Spoon oars		Pillows
Pillows	Keying rings			Ditty boxes		Mattress covers
Mattress covers	Chain cables			Cargo nets		Pillow covers
Pillow covers	Pendants, clear hawse			Breaker stands		Angle hose valves
Racks for hand fire grenades	Shackles, cable, spare					Flanges for ventilation pipe
Coaling blocks	Shackle keys					Boat hooks
Speed cones	Shackle-pin tools					Boat chests
Ready mixed paints	Shackle-pin forelocks					Wood fenders
	Shackle-pin keys					Anchor buoys
	Skackle pins					
	Stoppers, bitt					
	Stoppers, deck					
	Stoppers, pelican hook					
	Stoppers, with turnbuckle					
	Stoppers, ring					
	Tents					
	Signal-flag Chests					
	Vegetable lockers					
	Voice-tube fittings					
	Hammocks					
	Fittings for hoisting steamers					
	Boat slings, chain					

It will be seen from this table that each of the industrial yards is charged with the economical manufacture of certain standard articles, and as these articles are produced in fairly large quantities, repeat orders being, of course, frequent, our navy yards to-day partake more of the nature of pure manufacturing establishments than ever in the past.

In order to keep track of the cost of manufacture of such standard articles, it is necessary to have such a system of manufacture that the shop superintendent or production manager may tell, as he goes through the shops on his frequent tours of inspection, just what progress is being made on any job, and what the direct labor cost is, so that, if necessary, steps may be taken to effect any possible economies.

Every job for the manufacture of standard articles is capable of being split up into a number of smaller jobs or operations. These smaller jobs or operations may be made many or few, depending upon the article that is to be manufactured and upon the discretion of the production manager. It is, therefore, possible to analyze each job and to make out for that job a set of standard operations as hereafter shown. These operations can and should be revised from time to time as new ideas are presented to the production manager, which will tend to reduce the cost of manufacture.

As a simple illustration take, for example, the manufacture of 100 food trays for sick-bay berths. These articles are described by specifications and consist of a brass pan about 14 inches x 22 inches x 1 inch deep, having four legs of such shape as to easily rest upon a sick-bay pipe berth, the tray being nickel-plated. The operations for the manufacture of 100 of these food trays are as follows:

SHEET METAL SHOP.

Operation No. 1.—Mark and cut out 100 pieces of sheet brass as per template for 100 food trays.

Operation No. 2.—Press out brass for 100 food trays.

Operation No. 3.—Anneal pans for 100 food trays.

Operation No. 4.—Trim and turn edges of 100 pans for food trays.

Operation No. 5.—Wire edges and smooth up edges of 100 pans for food trays.

Operation No. 6.—Solder corners of 100 pans for food trays.
Operation No. 7.—Cut out pieces of brass for legs of 100 food trays, 2 inches wide x 10 inches long.
Operation No. 8.—Hem edges and form up 400 pieces of brass for legs of 100 food trays.
Operation No. 9.—Press to shape 400 legs for food trays.
Operation No. 10.—Drill holes in pans and in legs for riveting 100 food trays.
Operation No. 11.—Rivet 400 legs on 100 food tray pans.
Operation No. 12.—Buff 100 food trays and prepare for nickel-plating.
Operation No. 13.—Nickel-plate and finish buffing 100 food trays.

From these detailed operations, it is seen that the manufacture of this article consists in marking out, pressing, wiring, buffing, riveting, and electroplating, each of these being separate and distinct jobs. The instructions for each operation are written on instruction cards and assigned to the various machines. When work is started on an operation, the time of starting is entered on the back of the instruction card and likewise, upon completion, the time of finishing is entered also. From these two entries, the time and the direct labor cost for the operation are easily obtainable, and this is the cost which the production manager must study and analyze if he desires to reduce the cost of production of the article. It should not be understood that the material and indirect costs are to be entirely ignored. Although material is generally fixed by specifications, at times other material, just as good as that specified, but of lower price, can be used to advantage for the desired purpose, and the production manager should also study the returned cost from this point of view. The indirect cost should, of course, be studied, but it is the hardest element of total cost for the production manager to control, inasmuch as a great many of the items which compose indirect expense are beyond his reach.

A divisional officer on board ship in training guns' crews selects his men, details them to the best advantage, that is, to the station for which they are best adapted, drills them and observes their motions, and introduces any little scheme whereby one second or a fifth of a second may be clipped off his loading time. In somewhat the same way, the production manager at a navy yard

studies the results obtained from the operation cards in the hope that hours may be clipped off future jobs of a similar nature. Frequently such study or analysis will show (1) that certain operations can be performed by lower priced men; (2) operations done by hand may be more profitably done by machinery, using dies, jigs, multiple patterns, etc., which makes it necessary to revise the standard operations; (3) competition may be introduced by assigning the same operations to different workmen, it being noted that, in this manner, a mechanic may be found who is especially adapted to the class of work under consideration. At this point, it is pertinent to note that, while there is no method in use at present at navy yards whereby a bonus or other reward may be received by navy yard workmen (there being also only a few yards where piece work is in use), the bonus system is practically in effect on board ship, in that prizes and higher rates of pay may be obtained by winning guns' crews and members of the engineer's force if the gun wins out at target practice, and the ship wins out in the engineering competition.

In the preceding paragraph, the methods of reducing costs have been outlined. The most important of these and the one which yields the largest returns is the substitution of machinery for hand labor, and the use of dies, patterns, templates, etc., wherever possible. As there are even at the present day some mechanics who have a grudge against labor-saving machinery, it is necessary for the shop superintendent (1) to have a knowledge of the capacity of the machinery at his disposal, and (2) to be thoroughly familiar with the method of manufacturing all standard articles, in order that slow and expensive methods may be replaced by economical ones. As an illustration of this, ditty boxes and camp chairs, camp stools, etc., which are given one coat of oil before shellac and varnish are applied, can be dipped in a small tank of oil by a laborer or helper in much quicker time than it takes the most expert painter to apply a coat of oil over the same article with a brush, and, in addition, the former method is believed to produce better results. It should be noted in these cases that, while the actual decrease in cost is effected by the use of labor-saving machinery, the necessity for the use of the same is brought to light by a study of the operation cards previously mentioned. A number of other cases where the cost of work has been reduced by the use of similar methods have also come within the experience of the writer.

The experience gained from these cases shows that, while the mere systematization of methods has a certain value of its own, and effects a saving in manufacture, the great gains are made by locating and remedying the leaks pointed out by the operation cards. It will be seen that this method bears a striking resemblance to the practice of making time studies on manufacture work.

A very important factor in connection with the unit cost of any article is the number of such articles that are manufactured in one lot. This principle applies in the manufacture of practically all articles. The unit cost of sailing launch masts, for instance, is less when these masts are manufactured in lots of ten than when they are manufactured singly. Likewise the unit cost of ditty boxes made up in lots of 100 is much more than the unit cost of boxes made up in lots of 1000. One reason for this, of course, is plainly evident in that the working gang have a better chance to warm up and do better team work on the larger lot than on the smaller. The principal reason, however, is determined from an analysis of the movements which make up an operation, and it may be here remarked that, in some systems of manufacturing, these movements are also known as operations, and are embodied in the written instruction sheet. The analysis of each operation shows that a certain amount of time is taken up in setting up a machine, which is the same for one article as for 1000. This is the principal reason why the unit cost of large lots is less than the unit cost on small lots, and can be seen from the following demonstration.

As the total direct labor cost is a function of time, it will suffice to show that the unit time on large lots is less than on small lots manufactured.

T_1 = total time for operation No. 1.
T_n = total time for nth operation.
t_1 = time required for putting the raw material through one complete cycle, *i. e.*, taking a sheet of brass, putting it through the press and putting the pressed pan in a second pile.
t_1^1 = time consumed in setting up the machine, which is the same for one article as for 500 or 1,000.
a = number of articles being manufactured.
T = total time for job.

Then $T=T_1+T_2+\ldots.T_n$.

$T_1=at_1+t_1^1$.

$T_n=at_n+t_n^1$.

$T=a(t_1+t_2+\ldots.t_n)+(t_1^1+t_2^1+\ldots.t_n^1)$.

Unit time of manufacture $=\frac{T}{a}$.

$$\frac{T}{a}=t_1+t_2+\ldots.t_n+\frac{(t_1^1+t_2^1+\ldots.t_n^1)}{a}.$$

It will be seen from this that as a is made large, $\frac{T}{a}$ may be to approach $t_1+t_2+\ldots.t_n$. On large orders $\frac{(t_1^1+t_2^1+\ldots.t_n^1)}{a}$ is very small and is practically negligible; on small orders and especially for articles which are composed of a number of machine operations, $\frac{(t_1^1+t_2^1+\ldots.t_n^1)}{a}$ is appreciable. This is the reason why manufacturing divisions at navy yards object to manufacturing articles in small quantities. Another important reason for turning out articles in large quantities (which, however, has no bearing on the cost, but which should be mentioned) is the large saving which can be made in clerical work in the offices of the General Storekeeper, manufacturing department, and accounting officer.

Some years ago there appeared in the NAVAL INSTITUTE a discussion of the wide variations in cost at navy yards of the same article when manufactured at different navy yards, and the article when manufactured at different times in the same yard. From the treatment of this question at present, it may be seen that the variation in unit costs is very likely to occur. Wide variation in costs should, however, be investigated. Invoiced prices are to be looked on with suspicion as they are frequently the result of an appraisal made from ignorance, an example of this being the appraised value of two life buoys which recently came within the writer's observation, namely, $90 each. The buoys in question needed repairs to the amount of $15 each to make them as serviceable as new buoys. If a re-survey and appraisal had not been made, these buoys would have been invoiced back to store at about $105 each, whereas the cost of new buoys is about $65 each. With manufacturing distributed to the various yards, as shown in the foregoing pages, the only permissible variation in cost should be

in the nature of reduction. As an example of the fairly constant price at which articles are now manufactured, may be mentioned the unit cost on three orders of ditty boxes completed at the Portsmouth yard during the past year, these orders being for 1500, 1000, and 800 boxes, on which the unit costs were $1.84, $1.732, and $1.737, respectively. The higher cost of the lot of 1500 over smaller lots is caused by a difference in material cost. Manufacturing conditions in navy yards are more standardized to-day than they were when the discussion referred to at the beginning of this paragraph appeared in these PROCEEDINGS.

In commercial life to-day competition is extremely keen, and manufacturing establishments take every chance to increase the volume of their business. Competition between navy yards is also more intense to-day than ever. The yard which can secure a large volume of varied manufacture work has a much better chance of preserving a constant working force. Men naturally do not work as efficiently if they know that discharges are to be made in the near future; hence, the importance of manufacture work to a yard which desires to maintain a fairly constant and efficient working force which will lead to a general high efficiency in the yard as a whole.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A HALF CENTURY OF NAVAL ADMINISTRATION IN AMERICA, 1861-1911.*

By CHARLES OSCAR PAULLIN.

I.

THE NAVY DEPARTMENT DURING THE CIVIL WAR, 1861-1865.

With the inauguration of Abraham Lincoln on March 4, 1861, there began at Washington a new administrative régime, destined to be long-lived, and to exercise a great influence upon the nation. New men, animated with fresh purposes and trained in a different political school from that of their predecessors, took up the work of Federal administration. The executive departments passed from the Democrats to the Republicans. With the exception of the Harrison-Tyler and Taylor-Fillmore administrations, the Democrats had been in power since the first inauguration of Andrew Jackson, on March 4, 1829. Disregarding Grover Cleveland's two administrations, the Republicans at the end of the administration of President Taft will have controlled the departments continuously since March 4, 1861—a period of fifty-two years.

On the coming of Lincoln, Southern influences, which for twenty years had predominated in the Navy Department, yielded to Northern. The Southern line of Secretaries of the Navy was succeeded by a new Northern line. The first Secretary under the Republicans was Gideon Welles, of Hartford, Connecticut. Welles served longer than any of his predecessors; and, up to the present time, than any of his successors. Two Secretaries, however, served almost as long—Robert Smith, 1801-1809, and George M. Robeson, 1869-1877. Welles's term extended from March 5, 1861, to March 3, 1869, and covered the administrations of

*Articles by the same author on the subject of Naval Administration in America have appeared in the PROCEEDINGS Nos. 119, 120, 122, and 124. This present series continues the subject.

Abraham Lincoln and Andrew Johnson. This period of eight years forms an important and well-defined era in naval history, since it is marked by the rise and decline of the navy of the Civil War. The first four years saw the rise, and the second four the decline of the navy. The former period, that of Welles's first administration, is practically coincident with the Civil War, and is treated of in this and the succeeding chapter.

The task of Secretary Welles from 1861 to 1865 was of greater magnitude and diversity than that of any of his predecessors. For four momentous years it was his lot to work and suffer with Lincoln under the heat, burden and turmoil of civil conflict. Many new duties unknown to the piping times of peace fell to him, and the old and usual duties of the naval office were greatly complicated, and were rendered important and insistent by the needs of war. The rusty machinery of the Department had to be repaired, lubricated, and enlarged. The thunderbolts of war had to be forged. Officers, sailors, and ships—the staples of navies—had to be supplied in great numbers. From 1861 to 1865 the number of ships increased from 90 to 670; of officers, from 1300 to 6700; and of seamen, from 7500 to 51,500. The annual naval expenditures rose from $12,000,000 to $123,000,000. With Welles rested the final decision respecting all shipbuilding programs, the principal plans of naval operations, and the general lines of naval policy. He was held responsible for the blunders and failures of the Department and the navy.

Gideon Welles was descended from the best stock of Connecticut. The original emigrant of his family to that state, Thomas Welles, held many important public offices between 1639 and 1659, being twice elected governor of the infant colony. Gideon was educated at the Episcopal Academy, in Cheshire, Connecticut, and at the Norwich University. He read law, and at the age of twenty-three became editor and one of the proprietors of the *Hartford Times,* which he edited until 1837. From 1827 to 1835 he was a member of the Connecticut legislature. For several years he served his state as comptroller of public accounts, and for some five years was postmaster of Hartford. From 1846 to 1849 he was chief of the Bureau of Provisions and Clothing in the Navy Department, at Washington.

In politics, Welles was for many years a Jacksonian Democrat. His anti-slavery views, however, carried him into the Republican

party, and in 1856 he was its candidate for Governor of Connecticut. He was a leading contributor to the *Hartford Evening Press*, the Republican organ of his state. For several years Welles was a member of the Republican National Committee. He was a delegate to the Republican National Conventions of 1856 and 1860, serving in the latter year as the chairman of the Connecticut delegation. During the presidential campaign of 1860 he labored earnestly for the election of Lincoln.[1]

In November, 1860, Lincoln began to consider various men for places in his cabinet. Welles's name was one of the first presented to him, and was the subject of a special consultation. Vice-President Hannibal Hamlin urged Welles's appointment. Senator John P. Hale, a New Hampshire politician of unsavory repute, was rather earnestly pressed upon the President for Secretary of the Navy, and he was somewhat mortified that his pretensions for the place were not more seriously regarded. Other names may have been considered. Lincoln, however, was from the first convinced of Welles's fitness, availability and representative character, and decided to invite him to a seat in the cabinet.[2]

The assignment of Welles to the Navy Department instead of to some other secretaryship may be ascribed to his three years' experience as chief of the Bureau of Provisions and Clothing, and to his residence in New England, whose maritime interests have given her a claim upon the naval portfolio. In making up his cabinet, Lincoln apportioned its members according to their sectional residence and their party antecedents. Welles was chosen as the New England member, and as a representative of the Democratic element of the Republican party. The early Republicans, it is recollected, were recruited principally from the Whigs, Democrats, and Free Soilers. The Whig faction was not generally friendly to Lincoln's naval secretary. Within the cabinet no love was lost between Welles and the Secretary of State, William H. Seward. In December, 1860, Thurlow Weed, one of the leaders of the Whigs in New York, spoke to Lincoln against his choice of Welles for the naval portfolio. Weed, so the story goes, said to the President that if he would, on his way to his inaugu-

[1] Boynton, Navy during the Great Rebellion, I, 22-24.

[2] Manuscript Papers of Gideon Welles in the possession of Mr. Edgar T. Welles of New York City; Nicolay and Hay, Lincoln, III, 367; Diary of Gideon Welles, vol. I, p. xxi.

ration in Washington, stop long enough in New York, Philadelphia, or Baltimore, to select an attractive figurehead from the prow of a ship, would adorn it with an elaborate wig and luxuriant whiskers, and would transfer it to the entrance of the Navy Department, this figurehead would be quite as serviceable to the navy as Welles, and much less expensive. "Oh," Mr. Lincoln replied, "wooden midshipmen answer very well in novels, but we must have a live Secretary of the Navy."[3]

Welles's "elaborate wig and luxuriant whiskers" gave him a patriarchical appearance, which his age and vigor of mind belied. When he entered the cabinet he was in his fifty-ninth year. Secretary of State Seward and Secretary of War Cameron were older than the Secretary of the Navy, and Attorney-General Bates was ten years his senior. Among the naval officers and sailors his paternal and benevolent aspect won for him the familiar appellation of "Father Welles," or "the Old Man of the Sea." Mr. Charles A. Dana, for a time an Assistant Secretary of War to Edwin M. Stanton, has left us one of the best characterizations of Lincoln's naval secretary. "Welles was a curious-looking man," Dana said, "he wore a wig which was parted in the middle, the hair falling down on each side; and it was from his peculiar appearance, I have always thought, that the idea that he was an old fogy originated. I remember Governor Andrew, of Massachusetts, coming into my office at the War Department one day, and asking where he could find 'that old Mormon deacon, the Secretary of the Navy.' In spite of his peculiarities, I think Mr. Welles was a very wise, strong man. There was nothing decorative about him; there was no noise in the street when he went along; but he understood his duty, and did it efficiently, continually, and unvaryingly. There was a good deal of opposition to him, for we had no navy when the war began, and he had to create one without much deliberation; but he was patient, laborious, and intelligent at his task."[4]

Welles was sometimes unjustly regarded as a time-serving, routine-loving secretary, a friend to red-tape. It is true that he was not one of those dashing administrators, who reach conclusions by intuition, put their decisions into effect with great

[3] Weed, Autobiography, I, 606-607, 611.
[4] Dana, Recollections, 170.

strenuosity, and are at once the inspiration and the terror of their subordinates. Rather, he was the quiet, unswerving, fearless executive, who reasons carefully from the evidence, and draws temperately his conclusions therefrom, who enforces his judgments with firmness and uniformity, and who gains the esteem of his fellows by reason of his patience, integrity, and justice. His qualities were solid, and never showy. While he had his antipathies, he nevertheless administered the navy as a rule with great impartiality. That he distributed the honors and rewards at his disposal without prejudice and bias, did not always appear to be true to those officers who were disappointed in not receiving their share of distinctions, and there are always many such officers during a war. Could they have known the mind of the Secretary of the Navy, they would have found that his decisions were based upon just principles of administration and the information presented to him.

Welles applied the laws of the navy fearlessly and without favor, no matter what the rank of the offender. He stood, as few Secretaries have, for naval discipline and an impartial administration of the naval code. More than once he rebuked a naval court for bringing in a verdict contrary to the evidence presented to it. A court-martial, of which Farragut was president, found the captain of a certain ship guilty of failing to do his utmost to overtake and capture a certain Confederate vessel, an offense punishable with death. The court sentenced the offending officer to be suspended from the navy for two years on leave-of-absence pay—a mere nominal penalty. Welles in reviewing these absurd findings pointed out that the sentence of the court would be too mild for a trivial offense, and declared that such punishment as the court had prescribed "no officer could obtain from the Department as a favor."[1]

Welles was generous in his praise of gallant and meritorious conduct. His congratulatory messages to the victorious naval officers were warm and hearty, and felicitously phrased. As a newspaper writer, he had acquired considerable facility in composition, and his official reports are therefore more interesting reading than most documents of this sort, usually so dry, commonplace and dispiriting. Unlike some of the Naval Secretaries, Welles did not depute to his subordinates the composition of his

[1] Official Records, ser. I, vol. 3, pp. 467-470.

annual reports, although he availed himself of their criticisms and suggestions. His writings reveal a faculty for lucid expression, clear thinking and the discernment of the gist of any subject. From the diary which he kept during and after the war, a recently published document of great historical value, one gathers that its author was methodical, painstaking and honest, and fearless in criticising his colleagues.*

In determining the policy of the government, Welles's advice was much valued by the President. His knowledge of public affairs was seasoned, and his judgment was sober and generally well balanced, but his counsel was not always politic. In the Mason and Slidell episode, he wrote a warmly congratulatory letter to Captain Wilkes, whose acts were finally disavowed by the President. That the Secretary of the Navy should have had a profound knowledge of international law was, however, hardly to be expected. Regarding the government's powers under the constitution, Welles took a middle ground, being neither a strict nor a broad constructionist. He and the Secretary of State were instinctively opposed to each other, and were usually on opposite sides of the questions that came before the cabinet. Welles regarded Seward as an intriguing and designing politician. He held, on plausible grounds, that Seward's conduct during the first weeks of Lincoln's administration was, if not traitorous, certainly highly unpatriotic. The Secretary of the Navy possessed none of those superb delusions that sometimes afflicted Lincoln's brilliant Secretary of State. On matters lying within the field of his information, his judgment was certainly as reliable as that of his colleague in the State Department.

Early in the war Welles and Seward did not get along well together, and some grave misunderstandings arose between them. At one time Welles and Secretary of War Stanton engaged in a serious altercation over the exchanging of prisoners. Several naval officers, notably Dupont, Wilkes, and Preble, had unpleasant differences with the Secretary. For all his controversies, it must be said, Welles had ample grounds. A fearless executive, intent upon the performance of his duties, is certain to have more or less trouble with his subordinates and colleagues. Some of Welles's critics, however, hold that his disputes reveal defects of character common to New Englanders—a lack of tact and sympathy, an

* See The Diary of Gideon Welles, 3 vols. (1911.)

arbitrary and inflexible mind, and an inability to understand an opponent's point of view.

To a technical and intimate knowledge of the navy, Welles made no pretensions. He, however, was better equipped for his duties than most Secretaries have been. His three years' service in one of the naval bureaus had given him a considerable acquaintance with the business of the Department. Fortunately, the limitations in Welles's naval knowledge were adequately compensated by the extensive professional information of his Assistant Secretary, Gustavus V. Fox, whose selection by President Lincoln as Welles's aid in the Navy Department was a most happy one.

At the beginning of the war Fox was in his fortieth year. He was born in Saugus, Essex County, Massachusetts. His father was a country physician, in moderate circumstances. At the age of sixteen young Fox was appointed midshipman in the navy, where he remained for eighteen years, and had a most varied naval career. He served in the Mediterranean, East Indian, Pacific, Brazil, and African squadrons, participated in the naval operations of the Mexican War, and for a time assisted in the work of the Coast Survey. In 1853-1854 he commanded a mail steamer, plying between New York and the Isthmus of Panama, and belonging to one of the subsidized steamship lines. In July, 1856, having reached the rank of lieutenant, he resigned from the navy and accepted the position of "agent" of the Bay State Woolen Mills, at Lawrence, Massachusetts. Early in 1861 he came to Washington with a plan for the relief of Fort Sumter, and in April President Lincoln permitted him to put it into operation. In planning, promoting and conducting this daring adventure, he displayed such energy, tact, and initiative, that the President was most favorably impressed with him. These qualities, together with the strong influence of his family connections, who stood close to Lincoln, soon brought him political preferment. On May 9, 1861, he was appointed chief clerk of the Navy Department, and on July 31 he was promoted to be Assistant Secretary of the Navy, a newly-created position.

Fox's career both in and out of the navy admirably fitted him for the assistant secretaryship. His long service in the navy gave him a wide acquaintance among the naval officers. He had acquired the habit of the navy and of the sea, and knew well the practice of the naval profession. On the other hand, his expe-

riences as a New England manufacturer had familiarized him with the currents of thought and action outside of the navy, with the methods of business, its economies and administration, and the qualities of commercial men. In the science of the naval profession, in contradistinction to its art, Fox was not especially well grounded. His knowledge of naval architecture was naturally limited, and his naval strategy proved to be at times faulty. He sometimes appeared more ready to plan, than laboriously to execute. Fox was decisive, quick of mind, and self-confident. No matter how dark and gloomy were the prospects of the Unionists, the buoyancy of his spirits never failed him. He was urbane and suave, and had a most engaging personality. The amenities of social life came easy to him. His father-in-law was Francis P. Blair, one of the leaders at the National Republican Convention of 1860; and his brother-in-law was Lincoln's postmaster-general, Montgomery Blair. During the war the Blairs were exceedingly influential in national politics. Few men, who in the eventful spring of 1861 came to the surface of that tempestuous political sea at Washington, were as likely as Gustavus V. Fox to survive in its rough waters and ride its waves to preferment and eminence.[7]

It is said that Fox was not Welles's first choice for the assistant secretaryship.[8] This may well have been, for the two men differed widely in professional training, habit of mind, and personal characteristics. Their official relations, however, were intimate, cordial, and unruffled by discords. Welles valued Fox's services highly, although he discovered certain shortcomings in him. Each gave to the other his confidence. As Assistant Secretary of the Navy, Fox was Welles's "chief of staff," his professional and confidential adviser. In choosing officers for important tasks, in formulating plans of naval operations, and in the execution of the technical business of the Secretary's office, Welles received the counsel and suggestions of his assistant, and largely acted upon them. In the work of the department, he gave Fox a remarkably free hand. Fox corresponded with many of the naval officers, sending them much valuable information, and often discussing with them their plans of naval operations. Notwithstanding these letters are personal, they assume a semi-official character by reason

[7] Nicolay and Hay, Lincoln, V, 4-5; Davis, Davis, 132-133.
[8] United Service, IV (1881), 36.

of the subjects discussed and the circumstances under which they were written. Respecting minor naval affairs, Fox gave official orders in his own name. Lincoln advised as freely with the Assistant Secretary as with the Secretary.

Both Welles and Fox had a great capacity for work, and each wrote with their own hands a vast number of letters. To their subordinates they often appeared fatigued and overworked. Night after night they toiled over their desks at the Department. In the course of his duties, Fox now and then visited the navy yards, or some of the principal seaports of the North. Infrequently, Welles and Fox went to the "front," the latter more often than the former. The Assistant Secretary of the Navy witnessed the fight at Hampton Roads between the *Monitor* and the *Merrimac*. In May, 1862, the Secretary of the Navy invited two or three members of the cabinet, the chief clerk of the Department, and several naval officers with the ladies of their families, to make a special cruise on the steamer *City of Baltimore*, and visit the Union fleets in the waters between Washington and Richmond. Such excursions must have brought to the Secretary and his Assistant a welcome relief from their arduous toil, and have given a brief diversion to their lives, so full of anxieties, vexations and discouragements.

It may be a little early, even yet, to apportion with nicety the respective shares of Welles and Fox in the management of the navy and the Department during the Civil War. It is plain that the Secretary of the Navy has not received sufficient credit for his services at the hands of historians. The brilliancy of Fox has somewhat obscured the deeper colors of Welles. To some writers it has appeared that the real power in the Department was the Assistant Secretary of the Navy, and that the Secretary was a sort of antiquated figurehead. While Admiral David D. Porter did not always write history with precision or impartiality, yet his estimate of Welles's services are worthy of consideration, coming as it does from a contemporary who was well situated for observation, fearless in the expression of his opinions, and not altogether friendly to the man about whom he was writing. In his naval history, Porter says that Gideon Welles was the responsible head of the Navy Department. "It was his judgment that decided almost all matters; it was his coolness and placidity of temper that controlled those around him and smoothed over the

little asperities and jealousies which would spring up among his subordinates—with a smooth word he brought back to his proper position any one who attempted to assume more than his rightful authority—in this way making a unit of the Department." Welles was the "judicial, financial, and political head, under whose directions everything was done; all plans were submitted to him, and no movement was made without his consent, and he weighed every matter before coming to a conclusion." According to Porter, Fox was the "able assistant," by virtue of whose aid the Secretary of the Navy accomplished his great work.[9]

The creation of the new post of Assistant Secretary of the Navy was earnestly desired by Welles. During the first months of the war his labors were so increased that the employment of an assistant was rendered imperative. Before the war the need of the Department for an official of this sort had been pointed out. In 1841 Lieutenant Matthew F. Maury had recommended the appointment of an "Under-Secretary" from the post-captains of the navy. Maury said that the Secretary "usually comes into office uninformed as to the condition of the navy, ignorant of its wants and usages, and unacquainted with the official character and standing of most of its officers. Accordingly he goes to work in the dark, and of course blunders and mismanagement ensue. It is a postulate granted by common sense, that a knowledge of details is as essential to the proper management of the navy as to the proper management of every other business, whether public or private." Maury wished, therefore, to attach to the Secretary's office a permanent official who should take charge of the detailing of officers, the shipping of seamen, and the equipment of vessels for sea. It may be said in passing that the duties Maury assigned to an Under-Secretary are at the present time performed in large part by the Bureau of Navigation and not by the Assistant Secretary of the Navy, who bears little resemblance to Maury's official.[10]

The first act authorizing the appointment of an Assistant Secretary of the Navy was passed on July 31, 1861. It did not enter into details. In the absence of the head of the Department, the new official was to act as Secretary of the Navy, and he was to

[9] Porter, Naval History of the Civil War, 360.

[10] Congressional Globe, 1861, p. 177; Southern Literary Messenger, VII, 24.

perform all such duties, in the office of the Secretary, "as shall be prescribed by the Secretary of the Navy, or as may be required by law." The salary attached to the new post was $4000 a year.[11]

During the first months of the war, the defects of the administrative system of the Navy Department were apparent. It was slow in adapting itself to the new conditions and in responding to the "executive touch." Indeed, early in the war the executive touch was not exercised with much confidence and precision. The weakness of the Secretary's office as a directing and unifying force was manifest. It was strengthened, as we have seen, by attaching to it an Assistant Secretary of the Navy. This may be regarded as a step towards unifying and correlating the work of the Department. The differentiating of the Department's functions, however, proceeded rapidly, and several new offices, bureaus and boards were created.[12]

One of the most important of the new departmental organizations was the "office of detail" which the Secretary of the Navy, on his own initiative, established as a part of the Secretary's office. Unfamiliar with the respective abilities and merits of the several naval officers, Welles, in March, 1861, ordered Commodore Silas H. Stringham to report to the Secretary's office for the purpose of assisting in the detailing of officers. On the breaking out of the war Stringham was detached, and his duties were vested in a navy board, or "office of detail." Commodore Hiram Paulding was placed at its head, and Commanders Charles H. Davis and Maxwell Woodhull were selected as its other members. Owing to Paulding's advanced age, the duties of chief of the office fell largely to Davis, who performed them until he was detached in the fall of 1861. In addition to the assignment of officers to duty, the office of detail had charge of the appointment and instruction of the volunteer officers. During the war it formed a part of the Secretary's office; but on April 28, 1865, it was placed in charge of the chief of the Bureau of Navigation.[13]

In his important reports of July 4 and December 2, 1861, Secretary Welles recommended, in general terms, a modification and

[11] U. S. Statutes at Large, XII, 282-283.

[12] Porter, Naval History of the Civil War, 20, 21; Church, Ericsson, II, 36; Davis, Davis, 146; Soley, Admiral Porter, 133.

[13] The Galaxy, X (1870), 624-626; Davis, Davis, 115-116, 121, 128, 133-134; Hamersly, List of Officers of the Navy, 1901, p. 4.

improvement of the organization of the Navy Department. He believed that the duties of the Department could be better distributed and classified. On January 24, 1862, Senator John Sherman, of Ohio, introduced in the Senate a bill providing for two new naval bureaus. In February there was substituted for Sherman's measure a "bill to reorganize the Navy Department of the United States," which provided for eight naval bureaus. One of these, among other duties, was to have the management of the Light House Service, but the friends of the Treasury Department prevented this innovation. The bill to reorganize the Navy Department became a law on July 5, 1862.[14] It established the following eight bureaus:

1. Bureau of Yards and Docks.
2. Bureau of Equipment and Recruiting.
3. Bureau of Navigation.
4. Bureau of Ordnance.
5. Bureau of Construction and Repair.
6. Bureau of Steam Engineering.
7. Bureau of Provisions and Clothing.
8. Bureau of Medicine and Surgery.

The act of July 5, 1862, which is still the basis of the organization of the Navy Department, increased the number of bureaus by three. The duties of the former Bureau of Equipment and Repairs were distributed among three new bureaus, Equipment and Recruiting, Construction and Repair, and Steam Engineering, and the duties of the former Bureau of Ordnance and Hydrography were divided between two new bureaus, Ordnance, and Navigation. Formerly, the chiefs of the several bureaus served during the pleasure of the President, but hereafter they were to be appointed for a term of four years. They were to receive $3500 a year, in lieu of all compensation as officers of the navy. The chiefs of the Bureaus of Yards and Docks, Equipment and Recruiting, Ordnance, and Navigation, were to be line officers, not below the grade of commander. The chiefs of the Bureaus of Construction and Repair, Steam Engineering, Medicine and Surgery, and Provisions and Clothing were to be, respectively, a

[14] Sen. Ex. Doc., 37 Cong., 1 sess., No. 1, 96; Ann. Rept. of Sec. of N., 1861, p. 22; Congressional Globe, 1861-1862, pp. 467, 761, 875-876, 1323, 1504, 2744-2745; U. S. Statutes at Large, XII, 510-512.

naval constructor, a chief engineer, a surgeon of the navy, and a naval paymaster, of not less than ten years' standing. The bureaus were to perform their duties "under the authority of the Secretary of the Navy, and their orders shall be considered as emanating from him, and shall have full force and effect as such"—a repetition of a provision of the act of August 31, 1842, instituting the bureau system. The new law provided for fifty clerks and draftsmen, which was a small increase in the clerical force of the Department. It further provided for an assistant chief in the Bureau of Ordnance, and a civil engineer in the Bureau of Yards and Docks.

The act of July 5, 1862, authorized the Secretary of the Navy to distribute the duties of the Department among the several bureaus as he should judge expedient and proper. The only important changes made in the distribution of duties were those necessitated by the establishment of the three additional bureaus. The duties of the Bureau of Equipment and Recruiting are sufficiently indicated by its name. The work of the Bureau of Steam Engineering related chiefly to the designing, construction and repairing of the steam machinery of ships. The Bureau of Navigation was made the scientific bureau of the Department. It owed its origin largely to Rear-Admiral Charles H. Davis, a progressive officer, who was much interested in promoting science within the navy. He was appropriately made its first permanent chief, entering upon his work in November, 1862, after the bureau had been organized by Captain James M. Gilliss. The Bureau of Navigation was given the supervision of the Naval Observatory and the Hydrographical Office, the Nautical Almanac Office, and the Naval Academy.

The chiefs of the naval bureaus during the Civil War were efficient and painstaking administrators, who were safe and conservative, rather than brilliant and aggressive. Several of them had been long in the service of the Department. Rear-Admiral Joseph Smith, the chief of the Bureau of Yards and Docks, entered the navy in 1809, and served with distinction in the War of 1812. He was chief of this bureau from 1846 to 1869. Paymaster Horatio Bridge, the life-long friend of Nathaniel Hawthorne, held the chiefship of the Bureau of Provisions and Clothing from 1854 to 1869. John Lenthall, of the Bureau of Construction and Repair, and William Whelan, of the Bureau of

Medicine and Surgery, each became head of his bureau in 1853, and served throughout the war. Lenthall did not retire from the chiefship until 1871. In 1865 Whelan was succeeded by his able assistant during the war, Surgeon P. J. Horwitz. Only a single bureau chief resigned to enter the Confederacy, Captain G. A. Magruder, of the Bureau of Ordnance. His successors were Captain A. A. Harwood, 1861-1862; Rear-Admiral John A. Dahlgren, 1862-1863; and Commander Henry A. Wise, 1863-1865. The work of these three chiefs was frequently commended for its promptness and efficiency. Dahlgren was the principal ordnance expert of the old navy, and during the war a close friend of President Lincoln. Davis, the first chief of the Bureau of Navigation, was succeeded in 1865 by Captain Thornton A. Jenkins. The first chief of the new Bureau of Equipment and Recruiting was an officer of the highest professional standing, Rear-Admiral Andrew H. Foote. During the war Davis and Foote rendered distinguished service on the Mississippi. The colonels-commandant of the marine corps were John Harris, 1861-1864, and Jacob Zeilin, 1864-1876.

The new Bureau of Steam Engineering was presided over from its organization in 1862 to 1869 by Engineer-in-Chief Benjamin F. Isherwood, a man of much originality, great independence of character and indefatigable industry. Unlike many of his colleagues, he was a comparatively young man. He was still living in 1912, the last survivor of the principal naval administrators of the Civil War. Before his appointment as chief of the new bureau, Isherwood was serving as engineer-in-chief of the Bureau of Construction, Equipment and Repairs. His work during the war, when a steam fleet was supplanting the old wooden one, was most exacting and important. It was sharply criticised, probably more so than that of any other chief of bureau. A recent writer seems to have completely vindicated Isherwood, who, he says, was the foremost man of the engineering corps in professional ability and zeal. Every demand made upon his bureau was promptly and efficiently met, and the standard of naval engineering during Isherwood's term of office was raised to an enviable height.[18]

At the very close of the war Congress created the office of naval judge-advocate general. Probably the first man to recommend the appointment of a permanent law officer, or officers, for the

[18] Bennett, Steam Navy, 202, 608-609.

navy was Secretary Crowninshield, in 1816. Many later secretaries made similar recommendations. On February 10, 1865, Secretary Welles wrote to the chairman of the House Naval Committee setting forth the need of the Department for a judge-advocate. He said that many "legal questions and suits growing out of the transactions of this Department are constantly arising. Some of them involve large pecuniary amounts, and frequently embrace great variety of detail. The cases of courts martial are numerous, and require scrutiny and careful preparation and revision. The forms and execution of contracts under the provisions of law demand deliberate and attentive care and consideration. Frauds and abuses on the part of contractors and employees call for investigation and prosecution, and the miscellaneous legal questions which arise are innumerable, involving often a vast extent and variety of detail." To take charge of these matters, and to advise the Department on them, a law officer was necessary. Welles enclosed the draft of a bill.[10]

Acting on the advice of the Secretary of the Navy, Congress, on March 2, 1865, authorized the appointment of a solicitor and naval judge-advocate general. He was to receive a yearly salary of $3500, and was to serve during the war and one year thereafter.[11] On March 6 President Lincoln appointed to the new post William E. Chandler, of New Hampshire, who many years later became Secretary of the Navy. On July 10, 1865, Chandler was succeeded by John A. Bolles, of Massachusetts, who served until 1870, when the office was discontinued and its duties transferred to the Department of Justice.

To assist him in his work, Welles created several temporary boards and agencies. The appointment of experts to advise and direct the Department or to perform some of its duties is a familiar device. By all odds the most important board instituted by Welles was the "Commission of Conference," the purpose of which was to determine the military and naval operations on the Atlantic and Gulf coasts, collect hydrographic, geographic, and topographic information, and to devise methods for rendering the blockade effective. It was especially to obtain such information as would be of value in capturing a naval base on the Atlantic coast of the Southern States. The notion of establishing this

[10] Congress Letters, II, 427; XIV, 236.
[11] U. S. Statutes at Large, XIII, 468.

commission originated with Professor Alexander Dallas Bache, the eminent superintendent of the United States Coast Survey. Its members were Professor Bache, Captain Samuel F. Dupont, and Commander Charles H. Davis, of the navy, and Major J. G. Barnard, of the engineer corps of the army. Dupont was its senior member, and Davis its secretary.

The Commission of Conference was organized in the latter part of June, 1861, and held its sessions at various times in July, August and September. It embodied the results of its labors in six reports, three relating to the Atlantic and three to the Gulf coast. Its views were developed by discussion, and were later written out by its secretary. The hydrographic and geographic information contained in its reports, which exceeded in amount that of a purely naval or military character, was chiefly derived from the records of the Coast Survey. The reports of the commission, which were discussed by the cabinet and by General Winfield Scott, of the army, proved to be valuable in formulating and executing the plans of naval operations. The commission was a confidential one, and its reports were not intentionally made public. Early in July, 1861, however, accounts of its deliberations began to be printed in the newspapers. It was impossible at this time to keep secret the work of the government, so successful were the friends and agents of the Confederates in obtaining information.[18]

In the spring of 1861 Welles instituted another confidential board. It was composed of the chiefs of the several bureaus of the Navy Department, and was charged with the duty of "considering and acting upon such subjects connected with the naval service as may be submitted to [them] by the Department for their opinion at this important juncture of our national affairs." It was further charged to make "such suggestions regarding the naval service generally as may occur to the board."[19] Commander C. H. Davis was its secretary.

In February, 1863, the Secretary of the Navy established the "Permanent Commission." Its original members were Davis, Bache and Joseph Henry, the secretary of the Smithsonian Institution. Its purpose was to report on all questions relating to

[18] Official Records, ser. I, vol. 12, 195-207; vol. 16, 618, 651, 680; Davis, Davis, 117-134; The Galaxy, XII (1871), 672.

[19] Davis, Davis, 117.

science and art upon which the Department wished advice, and it was authorized to call to its aid technical assistants. Many inventions, plans and devices, with which the government was flooded during the war, were referred to it for its opinion of their value. Until the end of the war it held frequent sessions, and transacted much business. The organization of this commission is of an additional interest, since it led to the founding of the National Academy of Sciences.[20]

Various other temporary boards, besides those above mentioned, were appointed by the Department during the war. There were, for instance, an "iron-clad board," a "harbor commission," a "board on steam expansion," a "board on plans and designs for new vessels," and a "board on parole of prisoners." The work and organization of the iron-clad board will be considered in another connection.

Since the construction and engineering bureaus in Washington were unfavorable to the building of vessels of the "monitor," or double-turretted iron-clad type, a sort of monitor bureau was created at New York. Rear-Admiral F. H. Gregory was placed at its head, and directly under him was Chief Engineer A. C. Stimers. This office had charge of the construction of all ships and engines of the navy, and especially of monitors and iron-clads built by private contract. Its staff of assistants, draftsmen and clerks was almost as large as the similar force of the Navy Department in Washington. It was sometimes called the "draftsmen's paradise," on account of the large number of employees of this class, and the large wages paid them, twenty dollars a day. Under Gregory were some forty-five or fifty naval officers, who were stationed at the various ports where the navy had work which was being performed under contract. "The New York section of the Navy Department" ran its affairs with a rather high hand. It was especially partial to the construction of monitors.[21]

Several agencies were established for the transaction of special duties. One of great importance was that of Mr. George D. Morgan for the purchase of vessels. The superintendence of the construction of certain light-draft monitors was intrusted to Chief Engineer A. C. Stimers. In March, 1863, Messrs. John M. Forbes

[20] Davis, Davis, 285-286, 289-290; Bureau Letters, IV, 153.
[21] Bennett, Steam Navy, 485; Buell, Charles H. Cramp, 79.

and Wm. H. Aspinwall were sent to England to prevent the sailing of the iron-clads that were being built there for the Confederates, but their mission was unsuccessful. At the outbreak of the war, most of the navy agents of the Department in foreign countries were discontinued, as there was little need of them, since from 1861 to 1865 but few vessels were maintained abroad. At London, however, the Baring Brothers continued to act as the financial agents of the Department. Navy storekeepers were employed at Spezzia and Panama.

The chief clerk of the Navy Department was an important official during the war. He had charge of the records, correspondence and personnel of the Secretary's office, and the finances of the Department. Charles W. Welsh, Toucey's chief clerk, was succeeded by Hobart Berrian on March 14, 1861; Berrian, by Gustavus V. Fox, on May 9; and Fox, by William Faxon, on July 31, who held the position until June 1, 1866. Faxon, like Welles, was a resident of Hartford, Connecticut. For many years he had been a friend of Welles, and had been associated with him in the work of the *Hartford Evening Press*. Faxon entered the Department on March 19, as a clerk of the second class in the Secretary's office. His fitness for this position was determined by a board of examiners appointed by the Secretary of the Navy—an early application of the principles of civil service to the Navy Department. Welles, Fox and Faxon were the New England trio that presided over the Department during the darkest period of its existence.

During the war the clerical work of the Department was considerably increased, though by no means to the extent one might suppose. The number of regular clerks and draftsmen employed in the Department at Washington in 1860 was 39, and in 1865, 66. The office hours, which were regularly from 9 a. m. to 3 p. m., were, for many clerks, greatly lengthened, and often extended into the night. On certain afternoons, however, some of the employees were dismissed at 2 o'clock, to engage in military drills and exercises. But few of them welcomed this relief from their desks, since they generally preferred their writing and accounting to the hauling about of brass howitzers in the hot sunshine. At the beginning of the war all the clerks were required to take an oath to support the constitution. In March and April, 1861, most of the clerks who sympathized with the Confederacy, about one-

fourth of the clerical force, resigned; and some of them found positions in the Confederate Navy Department. There remained in the Department throughout the war several employees who were unfriendly to the North, and who, in the opinion of the Unionist clerks, were at heart disloyal. In July, 1861, President Lincoln removed the Democratic navy agents in the several Northern ports, and appointed Republicans in their places. Welles was disinclined to remove any employees for political reasons or "offensive partisanship," and much clamor was raised against him for his forbearance. His stand was in striking contrast to that of some of his colleagues in the cabinet, who discharged the Democrats from their department by the wholesale. In order that the policy and action of the government should be uniform, Lincoln requested the Secretary of the Navy to remove a few Democrats from the Navy Department.

To meet the demands of the bureaus for additional quarters, a new wing and a third story were added to the old Navy Department building. It was situated a stone's throw to the westward of the White House. The rooms of Welles, Fox and Faxon were on the second floor, in easy reach of each other. Here throughout the war President Lincoln often called and chatted in the most informal manner, and his gaunt form became a familiar figure to the employees of the Department. A clerk, who is still living, remembers seeing him appear in one of the bureaus wearing "carpet slippers." Occasionally he wore a shawl over his shoulders—a common article of dress for men at this time. It was in the Bureau of Ordnance, while watching a German regiment pass the window, that Lincoln propounded the conundrum, "Why is an Amsterdam Dutchman like any other damn Dutchman?" The diary of Rear-Admiral John A. Dahlgren abounds with references to Lincoln's visits to the Department, and to the Washington navy yard. The following characteristic entry for March 29, 1863, may be quoted: "I went to the Department. Found the President in the Chief Clerk's room with the Secretary and Fox. He looks thin and badly, and is very nervous. Complained of everything. They were doing nothing at Vicksburg and Charleston. Dupont was asking for one iron-clad after another, as fast as they were built. He said that the canal at Vicksburg was of no account, and wondered that a sensible man would do it. I tried my hand at consolation, without much avail.

He thought the favorable state of public expectation would pass away before anything was done. Then levelled a couple of jokes at the doings at Vicksburg and Charleston. Poor gentleman!"[24]

The details of the naval business were of course generally managed by the Navy Department. The President, however, kept in close touch with the navy. As a rule, the orders of the officers were issued by the Secretary of the Navy. But infrequently, when the need of action was very great, they were written by the President himself.[25] Whenever the chief commanders were in Washington they always called upon Lincoln, and found him an eager listener to all they had to tell about their plans and operations. Farragut, Porter, Dahlgren, Dupont, Davis, Foote, and other leading naval men were often in conference at the White House. In the selection of officers for important commands, Lincoln generally followed the advice of the Department. Porter said that Lincoln seemed to be familiar with the name, character, and reputation of every officer of rank in the army and navy, and "appeared to understand them better than some whose business it was to do so."[26]

When Welles entered upon his duties on March 7, 1861, he found the Department and the navy in a deplorable condition. Many of the clerks were hostile to him. The disaffected officers of the Department maintained a rallying-point in the Bureau of Ordnance, whose chief, Captain George A. Magruder, and whose clerks, almost to a man, later allied themselves with the Confederacy. The Naval Observatory, under the command of Commander Matthew F. Maury, a warm friend of the South, was another center for the propagation of secessionist doctrines. The officers of the navy were more or less demoralized. Already several of them had resigned, and many others were suspected of disaffection to the Union. Captain Samuel Barron, one of the leaders of the clique of Southern officers favorable to the interests of the Confederacy, was exercising a considerable influence on naval affairs. It was impossible for the Secretary of the Navy to tell his friends from his foes. The Pensacola navy yard was in the hands of the Confederates. The situation at the Norfolk yard was by no means assuring. Among the officers of the Washington yard sentiments of disloyalty were common. All of the navy

[24] Dahlgren, Dahlgren, 390.

[25] Porter, Incidents and Anecdotes of the Civil War, 283.

yards were in bad repair, since no appropriations for their improvement had been made for several years. The national treasury was bankrupt. In pursuance of President Buchanan's policy, Secretary Toucey had failed to place the navy in a posture of defense. As was customary in peace, most of the vessels were on foreign stations. The home squadron in commission consisted of 12 vessels, carrying 187 guns and about 2000 men.

It was under these circumstances that Welles took charge of the Navy Department. A sharp turn in its policy might have been expected to signalize the advent of a Republican administration and Secretary of the Navy, but no sudden change of any sort took place. For the first three weeks Welles did almost nothing to increase or improve the naval defense of the country, and for the second three weeks he did but little. In the first days of April he prepared an expedition for the relief of Fort Sumter, and opened rendezvous for the enlistment of seamen at several Northern ports. Until the firing on Fort Sumter, the policy of Lincoln differed only slightly from that of Buchanan. It was one of conciliation and temporization; it was passive, hesitant, expectant, uncertain, cautious, and tentative. Lincoln and the members of his cabinet were not familiar with Federal administration, nor with each other, and at first they did not pull well together. They were strangely awkward at their new work, how awkward it is painful to tell. The attempts of the Secretary of State to manage the government and the President are well known.

Seward's interference with the affairs of the Navy Department greatly added to the confusion of the first weeks of the new administration. On April 1, without consulting the Secretary of the Navy, he obtained the signature of President Lincoln to a most remarkable naval document. It was addressed to Welles, and was in the handwriting of Captain Montgomery C. Meigs, of the army—with the exception of the postscript, which was written by Lieutenant David D. Porter, of the navy. The document was an order of Lincoln to Welles to make certain details of naval officers and certain changes in the organization of the Navy Department. Of special significance was the direction to Welles to detach Commodore Silas H. Stringham from the Secretary's office, to order him to Pensacola, and to supersede him as detailing officer with Captain Samuel Barron. The postscript,

which related to the organization of the Department, read as follows:

> As it is very necessary at this time to have a perfect knowledge of the personal of the navy, and to be able to detail such officers for special purposes as the exigencies of the service may require, I request that you will instruct Captain Barron to proceed and organize the Bureau of Detail in the manner best adapted to meet the wants of the navy, taking cognizance of the discipline of the navy generally, detailing all officers for duty, taking charge of the recruiting of seamen, supervising charges made against officers, and all matters relating to duties which must be understood by a sea officer. You will please afford Captain Barron any facility for accomplishing this duty, transferring to his department the clerical force heretofore used for the purposes specified. It is to be understood that this officer will act by authority of the Secretary of the Navy, who will exercise such supervision as he may deem necessary.[34]

These orders went far towards superseding Welles as Secretary of the Navy by Barron. In the management of the Department, they made the naval officer the more important official. Upon receiving them, Welles was greatly astonished, and he immediately, on the night of April 1, carried them to the White House for an explanation. Lincoln was much surprised to find that he had signed a document of such import. He said that Seward, with two or three young men, had been at the White House during the day on a matter which the Secretary of State had much at heart; and that he had signed the document without reading it, or knowing what it was, supposing that it related to an enterprise of Seward. Welles told Lincoln that he had no confidence in the fidelity of Barron, who was by the order forced into an official and personal intimacy with him, and was virtually given charge of the Department, that the establishment of a bureau by an executive order was unlawful, and that the proposition to make a naval officer Secretary *de facto* was illegal, and in his view "monstrous." The President replied that he knew nothing of Barron, that the document was not his, although he had signed it, and that Welles should treat it as cancelled. He expressed regret that he had blundered, and was wont afterwards to say that during the first weeks of his administration he and the members of his cabinet were all new to their work, and naturally made mistakes. Welles believed that the attempt of Seward and Porter to place the principal business of the Department in the hands of Barron

[34] The Galaxy, X (1870), 624.

was a movement in behalf of the Confederacy and the Southern naval officers. Barron was shortly dismissed from the naval service. He entered the Confederate navy, taking rank as captain, from March 26, 1861, five days before the date of the executive order giving him charge of the Federal Navy Department.[*]

Seward's interference with the Department was not confined to measures for its reorganization and to the detailing of naval officers. He planned a naval expedition for the relief of Fort Pickens, Florida, which was officered and fitted out, and had sailed before the Secretary of the Navy got wind of it. This was the enterprise to which Lincoln supposed the above-mentioned document related when he signed it. On April 1 Seward had obtained Lincoln's signature to a second document. This ordered Lieutenant David D. Porter to proceed to the New York navy yard and prepare an expedition for the relief of Fort Pickens. At this very time Welles was fitting out at the New York yard an expedition for the relief of Fort Sumter, which was to be under the command of Gustavus V. Fox. Both Welles and Seward intended that the *Powhatan* should sail as one of the ships of their respective fleets. It therefore happened that the orders which Seward had obtained from the President and those of Welles respecting this vessel conflicted. The commandant of the New York yard was naturally confused. Since the President's orders were superior to those of the Secretary of the Navy, he gave Porter possession of the vessel. Welles was completely in the dark as to Porter's movements, until about the time that Porter's fleet sailed from New York for Fort Pickens on April 6. On receiving intelligence of them he, in company with Seward, went to the White House and asked an explanation of the diverting of the *Powhatan* from the Fort Sumter expedition, which, he said, would fail for lack of this ship. Lincoln yielded to Welles, and decided that Porter should turn the vessel over to Fox. An order to this effect signed by Seward was sent to Porter, but he had already sailed. A tug was procured, and the orders reached him before he got to sea. He declined to detach the *Powhatan* from his fleet, on the ground that he was acting under orders signed by the President, while the countermanding orders were signed by the President's subordinate, the Secretary of State. The *Powhatan*, therefore, proceeded to Fort Pickens.

[*] The Galaxy, X (1870), 624-626.

Welles and Fox always maintained that the sending of Porter's expedition was one of the main causes of the failure of Fox's.[26]

Porter cannot be freed from all blame for the part that he played in these strange proceedings. He was a man of mature years and long naval experience. The postscript of one of the aforementioned documents was in his handwriting. Knowing well the routine of the Department, he must have been aware of the irregularity of Seward's acts. He must have foreseen that they would likely cause confusion. One might suppose that he had some knowledge of the character of Barron, and of that officer's unfitness for the management of the navy during the crisis of the spring of 1861. On the other hand, it may be said in behalf of Porter, that he was acting in accordance with the orders of his superiors, the President and the Secretary of State; and that, under the extraordinary circumstances that then existed, irregularities were to be expected.[27] When he accepted the command of the Fort Pickens expedition, he was under orders to proceed to the West Coast and report for duty on the Coast Survey, a detail which he had sought. Welles did not forget the part that Porter played in Seward's machinations. That he did not permit it to prevent the advancement of that gallant and meritorious officer, is a tribute to his fairness.

Looking in retrospect, one can now see that during the first weeks of Welles's administration no matter deserved more consideration than the holding and defending of the Norfolk navy yard. It was one of the three principal navy yards in the United States, and contained numerous dwellings, sheds, storehouses and machine shops, large quantities of tools, machines, naval stores and provisions, and some two thousand pieces of artillery. Connected with the yard was a commodious dry dock of granite, and near it were twelve ships. One of these, the *Merrimac*, when equipped for sea, was worth $1,200,000. The total value of all this property was estimated by the Department at $9,760,000. The Norfolk yard was strategically situated for the use of either the Unionists or Confederates. To the latter, at the beginning of the war, its ordnance stores were worth far more than their value in money. These facts did not receive the consideration by the

[26] The Galaxy, X (1870), 627-637; XI (1871), 105-107; Official Records, ser. I, vol. 4, 228-241; Diary of Gideon Welles, I, 16-26.

[27] Soley, Admiral Porter, 101-102.

Secretary of the Navy and the President that they deserved. It is not here urged that they should have provided for the defense of this yard independent of the general policy of the administration. But certainly they should not have formulated their general policy independent of its effect upon the holding of the yard.

During the first weeks of his administration Lincoln's policy was to do nothing that might offend those Southern States that still remained in the Union. He was especially considerate of the feelings of the Virginians. While some slight measures for the defense of the Norfolk yard were taken late in March and early in April, 1861, not until about the time that the Old Dominion seceded from the Union were any vigor and decision respecting this establishment shown by the administration. On April 16, Welles ordered Commodore Hiram Paulding to proceed from Washington to Norfolk, and to consult with the commandant of the yard, Captain C. S. McCauley, about its defense and the protection of its ships. Paulding carried an order to McCauley that rang with true mettle, the first issued by the Department for several months, of which this may be said: "The vessels and stores under your charge," the order read, "you will defend at any hazard, repelling by force, if necessary, any and all attempts to seize them, whether by mob violence, authorized effort, or any assumed authority." During the next four days the Department showed considerable activity. Unfortunately its efforts were too late. McCauley and Paulding, who were in positions of authority, did not rise to the occasion. They were too old, too long schooled in routine, to accomplish great things in a sudden emergency. McCauley lacked energy and initiative, and he was largely under the influence of his disaffected officers, who were Southerners, and who did their utmost to deceive him as to the real situation of the yard. On April 20, fearing an attack on the ships, he ordered them to be scuttled. They were sinking when Paulding arrived from Washington with new orders. The two officers now decided not to attempt a defense, but to destroy all the public property, and to abandon the navy yard. Their work of destruction was hasty and ill executed, and much property fell into the hands of the Confederates.

Possession of the Norfolk navy yard with its valuable supplies was of great service to the South. Its cannon were used in fortifying the forts and batteries of the Confederacy on the Atlantic

and Gulf coasts, and the Potomac, York, James, Rappahannock, and Mississippi rivers. The *Merrimac* was raised and converted into a terrible engine of war. Its dramatic contest with the *Monitor* made its name famous. The granite dry dock was little injured. Many of the workshops, with their valuable machinery, escaped harm. Admiral Porter said that, "but for the misfortune of losing, or we may say throwing away, the Norfolk navy yard, all the unarmed ports of the South would have easily fallen into our hands." The evacuation of Norfolk and the Norfolk navy yard was one of the greatest blunders of the war.*

The naval war with the Confederacy properly began on April 19, 1861, with the issuing by President Lincoln of a proclamation of the blockade of the coast of the Southern States from South Carolina to Texas. From this time the Department prosecuted its work with much industry and with considerable vigor. On July 4, when the members of the Thirty-seventh Congress met in special session, Welles was able to make a very creditable showing of his activities and achievements. Shortly after April 19, the commandants of the Boston, New York, and Philadelphia navy yards were authorized to equip all the public armed vessels that they could purchase or charter, and a flotilla, with its rendezvous at the Washington navy yard, was fitted out for the defense of the nation's capital and the Potomac River. On April 30 the commandants of the navy yards and the naval rendezvous were authorized to enlist seamen to serve for one year. In the latter part of April seven vessels were chartered. By July 4, 82 vessels, carrying upwards of 1100 guns, and manned by about 13,000 men, exclusive of marines and officers, were in commission. The East Indian, Mediterranean, Brazil, and African squadrons, with the exception of one ship in each of the two latter squadrons, had been recalled. The Department had contracted for 23 gunboats, of about 500 tons burden each, and had made preliminary arrangements for the construction of several larger and fleeter ships. It was also expediting the construction of eight sloops of war at the Northern navy yards.

On April 27 the President issued a proclamation extending the

* The Galaxy, X (1870), 112-119; Sen. Rept. 37 Cong. 2 sess., No. 37, 1-123; Official Records, ser. I, vol. 4, pp. 272-313; Sands, From Reefer to Rear-Admiral, 225-229; Porter, Naval History of the Civil War, 62; Parker, Recollections of a Naval Officer, 206-207; Diary of Gideon Welles, I, 41-53.

blockade so as to include the ports of North Carolina and Virginia. On April 30 foreigners were notified of the effective blockade of Hampton Roads, Virginia. The blockading vessels along the extensive seaboard of the Southern States were placed under two commands. Flag-Officer Silas H. Stringham was given the command of the squadron on the Atlantic coast; and Flag-Officer William Mervine, that on the Gulf coast. Stringham arrived at Hampton Roads with his flagship *Minnesota,* on May 13, and Mervine reached the Gulf on June 8. Previous to the arrival of the latter, the mouth of the Mississippi River and several Gulf ports had been blockaded. By July 4, Stringham's squadron consisted of 22 vessels, 296 guns, and 3300 men; and Mervine's of 21 vessels, 282 guns, and 3500 men. Colliers had been purchased, and were transporting coal to the two squadrons.[28]

The first notable service of the navy in the war was performed by the Potomac flotilla in April and May, 1861, in defending Washington, and in keeping open the Potomac for the passage of transports and supply ships. The Confederates tried to get possession of this river, fortify its banks and cut off communication between Washington and the Chesapeake. The first naval officer that was killed in the war, Commander J. H. Ward, lost his life while in command of this flotilla. The history of the Potomac flotilla and that of the Washington navy yard are inseparable. Before the military forts and batteries were erected on the heights surrounding Washington, the navy yard, situated within the city on the Eastern branch of the Potomac, was the principal defense of the capital. On or about April 22 almost every officer in this yard, including its commandant, Captain Franklin Buchanan, resigned their commissions in the navy. On this day Commander John A. Dahlgren, who was in charge of the department of ordnance of the yard, was ordered to succeed Buchanan, and during the next few months he performed with great industry and efficiency the arduous work that devolved upon him.

During the latter part of April, and the whole month of May, 1861, when it seemed that Washington would certainly fall into the hands of the Confederates before an effective force of troops from the North could reach the city, the President often visited the Washington navy yard and consulted with Dahlgren, for whom he had a high regard. The excitement, gloom, anxiety and

[28] Sen. Ex. Doc., 37 Cong. 1 sess., No. 1, 85-98.

alarm of those memorable days were never forgotten by the residents of the capital. For some time after the arrival of the first troops, the situation was little improved in the minds of the terror-stricken inhabitants, as may be seen from the words of Commander C. H. Davis, written on May 25, at his desk in the Navy Department to his wife: "We have had an exciting time this morning. Poor Ellsworth's funeral; an attack on the New Jersey regiment at the Chain Bridge by the Virginians; and the report of a fight at Sewall's Point. The alarm guns were fired for the first time, and war has actually begun. The Navy Department is well prepared with rifles and revolvers. The bells are now ringing, and it would seem that the alarm continued. The Commodore, Woodhull, and the clerk are loading the muskets (rifles) in the room where I am now writing."[20]

Directly after the battle of Bull Run, the fear, excitement and consternation in Washington was more intense than they had been during the first days of the war. A letter of Davis, written on July 23, shows the effect of the defeat upon the personnel of the Department: "Yesterday was a day of the deepest gloom. It was a day that recalled the scenes of history and historical painting, in novels and in the drama. Great excitement prevailed. Notwithstanding the rain, people stood about in groups and talked mysteriously, or listened to some straggler from the other side. Many countenances wore expression of alarm, all of anxiety. It was a long time before the clerks could get to work; they sat in listless apathy. Woodhull, who was among the most excited, burst out, while I was sitting at the desk writing, into expression of astonishment at what he called my coolness; though, as there was no danger immediately threatening us, there was no occasion for the exhibition of coolness. He was running around in the pouring rain as if set in motion by springs, and unable to keep still. Such was the alarm that the storm which hung the heavens in black was hailed with delight as an impediment to the march of the rebels, who, it was feared, would follow up their retreating foes and invade the capital. I shared of course in the alarm and depression; but after I had made up my mind to put on my uniform and go into the intrenchments in the event of an attack, I felt better, wrote all the morning and two hours in the evening."[21]

[20] Davis, Davis, 143-146.

[21] Davis, Davis, 151-152.

(to be continued.)

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE LAUNCHING OF THE *NEW YORK*.

By NAVAL CONSTRUCTOR ROBERT STOCKER, U. S. Navy,

AND

NAVAL CONSTRUCTOR HENRY WILLIAMS, U. S. Navy.

And see! She stirs!
She starts—she moves—she seems to feel
The thrill of life along her keel,
And spurning with her foot the ground,
With one exulting, joyous bound,
She leaps into the ocean's arms!

—*Longfellow.*

The problem of launching a big ship presents many difficulties and complications. There are numerous chances for error, any one of which might prove fatal to the success of the launching, or indeed result in total loss of the vessel. A man-of-war usually is more difficult to launch than a merchant vessel of equal or even greater displacement, as the weights are concentrated over a shorter length, it is of greater beam and often though the structure is more complicated, its local strength and ability to withstand the concentrated loads incident to launching are less.

Another feature that renders difficult the launching of a large vessel is the human element that enters into the preparation and the actual operation. So many men are engaged on the work that the chance of error is correspondingly increased. Then, too, launchings, particularly in navy yards, are infrequent, and the personnel must be trained especially in each case, with a resulting less degree of efficiency than can be obtained in operations commonly carried out.

The launching of the *New York* was achieved successfully at the hour set, without any unfavorable incident, or undue difficulty in carrying out the program.

The static forces that act on a ship during launching are indicated in the diagram below. The motion of the ship along the launching ways is due to the component of the force of gravity:

$$G \sin \theta.$$

This movement is resisted by friction which is:

$$fG \cos \theta,$$

f being the coefficient of friction. In order that the vessel will move the condition represented by the following equation obviously must obtain:

$$G \sin \theta > fG \cos \theta,$$

or

$$f < \tan \theta.$$

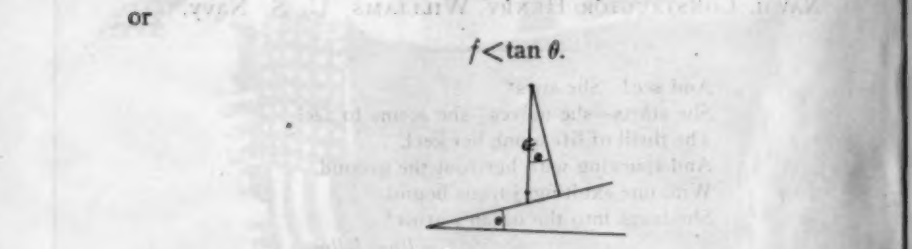


DIAGRAM SHOWING STATIC FORCES ACTING ON A SHIP DURING LAUNCHING.

The values of the coefficient of friction that may be expected under the usual conditions of launching are well known, having been determined carefully from data taken at previous launchings and experimentally in connection therewith. Thus the minimum admissible value of the angle of inclination of the launching ways is determined. It is customary to adopt an angle that will ensure the vessel sliding off, that will not give too great speed, and that is permitted by the conditions of construction of the vessel, the possibility of holding the ship and the depth of water available where the vessel is to be launched.

As the vessel slides down the ways and enters the water, the buoyancy of the submerged portion of the hull acts with an increasing force through its center of buoyancy which changes progressively in location. The force of gravity due to the weight of the vessel acts with a uniform force through its center of gravity, which is fixed. The launching ways, therefore, support a load continually lessening as the ship advances, and the resultant of the forces of reaction exerted by them changes correspondingly in amount and point of application. When the point of application of this resultant of the forces of reaction reaches the forward or shore end of the sliding ways, the stern of the vessel lifts and the ship "pivots" around the forward end of the ways or "fore-poppets." From this point the vessel is partly afloat, and it advances down the ways until either the end of the ways is reached and the ship drops off, or the ship becomes entirely waterborne.

If the center of reaction of the ways passes off the extreme end of the ground ways before pivoting takes place, the vessel will "tip," that is, the forward end will rise from the ways and the stern will drop. This condition must be avoided, as it will result generally in serious damage to the vessel through concentrating the support at a point where the structure is not able to stand it, or in straining the ship and "breaking its back." In order that these conditions may be understood and accidents guarded against, it becomes necessary before even the ship is laid down to make certain launching calculations. At first these are approximate and serve only as a guide to determine the inclination and limiting dimensions of the launching ways and the maximum possible weight of the hull that is to be launched. Later these calculations are made accurately and a diagram drawn which shows the conditions as they will exist actually.

The weight of the hull is determined from the weight records and from a consideration of the percentage of completion of the various groups as estimated in the original design calculations. This latter gives also the center of gravity of the structure as launched. As an indication of the accuracy obtained, the mean draft of the *New York* after launching was found to agree within less than one-half inch with the calculated mean draft. Displacements and centers of buoyancy are calculated for water-lines inclined to the angle of the launching ways, and from these the moments of the force of buoyancy around the fore-poppets are

Curves of Launching Data and Calculations of Various

AND CALCULATED VARIOUS FORCES AND MOMENTS ACTING.

calculated. This is the force that tends to cause the ship to pivot, which occurs when its moment around the fore-poppet becomes greater than the moment of the weight around the same point.

The pivoting point, therefore, is represented on the diagram by the intersection of the curve of the "moment of buoyancy about the forward end of the sliding ways," and the straight line representing the "moment of the weight of the hull" about the same point. By considering the curve of buoyancy, the force supporting the hull at this point is determined and the difference between this and the weight of the hull gives the pressure on the fore-poppets at the time of pivoting. This pressure, which in the case of the *New York* was calculated to be 2110 tons, requires special arrangements for its distribution, as, if localized, it would deform the hull. These arrangements will be discussed farther along.

In order to determine whether there will be a tipping force, curves are drawn showing the moment of the buoyancy around the outer end of the ground ways, and the moment of the weight of the hull around the same point. If these do not intersect there is no danger of tipping. In order that the vessel will not drop when the end of the ways is reached, the curve of buoyancy must pass above the line representing the weight of the hull at a point on the diagram represented as inshore of the end of the ground ways.

The calculations represented by the curves are made considering the ship as fixed at each point. This does not represent accurately the conditions when the vessel moves down the ways, when dynamic forces enter into play. Furthermore, due to the movement of the vessel in the water, there is a stern wave and consequent hollow, which has the effect of tending to modify the buoyant forces and no doubt causes the actual pivoting to take place at a different point than indicated by the calculations which are based on consideration of static forces.

Very great care must be exercised in making the calculations and providing against all contingencies, as unforeseen circumstances may prove fatal to the success of the launching, or even cause the loss of the ship. For example, in the case of the launch of the French ship *Danton*, at the Brest naval arsenal, in May, 1909, the vessel stopped on the ways after moving only about 160 feet. It became necessary to rebuild the launching ways and the vessel was not launched until forty-two days later. The

difficulty was caused by the fact that account was not taken of the unusual resistance of the water caused by the launching of the ship between two parallel walls at a short distance on each side.

THE BUILDING SLIP.

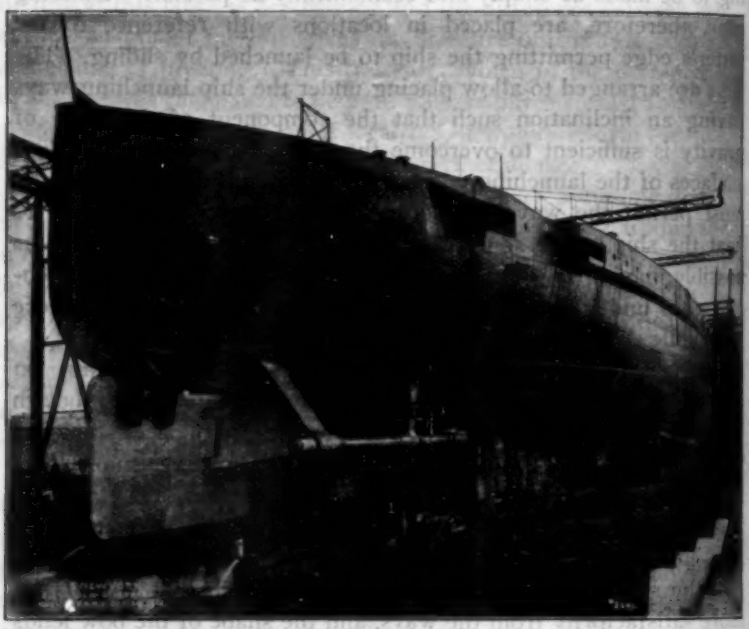
The question of the successful launching of a ship is considered before it is laid down on the building slip, which must be designed to permit the necessary arrangements for the launching to be made as simply and economically as possible. Building slips, therefore, are placed in locations with reference to the water's edge permitting the ship to be launched by sliding. The slips are arranged to allow placing under the ship launching ways having an inclination such that the component of the force of gravity is sufficient to overcome the friction between the sliding surfaces of the launching ways. At the same time the inclination must permit the ways to be carried into water deep enough to float the ship. The slip is arranged with as small inclination as possible, having in view the necessity later of placing the launching ways under the ship, and of providing clearance for the fore foot while sliding down the ways and after pivoting.

Large ships are launched almost universally stern first on sliding ways, which extend in the direction of their length, though infrequently, due to restricted water or building space, ships are launched broadside on. The reason for launching ships stern first rather than bow first is somewhat in question. The practice has been followed many years, and it lends itself satisfactorily to new conditions as they arise. The principal reason is probably that the shape of the stern of the vessel is such that it floats off more satisfactorily from the ways, and the shape of the bow lends itself better to suitable poppet packing. Then, too, more resistance is offered in this way by the water and the length of the run is accordingly less.

Frequently special measures are necessary to reduce the speed of the vessel after it is launched on account of restricted water. No such steps were necessary for the *New York* as there is ample space in the East River in the direction in which she was launched, and the deep after packing, five feet thick in itself, offered considerable resistance.

The principal difficulties of launching large vessels are those that result directly from the necessity of shifting the support of

the weight of the hull, which in the case of the *New York* was about 9700 tons, not including 500 tons of packing and sliding ways, from the blocks, cribbing and shores on which it is constructed, to the launching ways which must support the vessel partially during the last few days before launching, and entirely in a short interval before launching and during launching. The building supports consist of keel blocks spaced at 4-foot intervals; a number of large cribs consisting of crossed 12-inch square

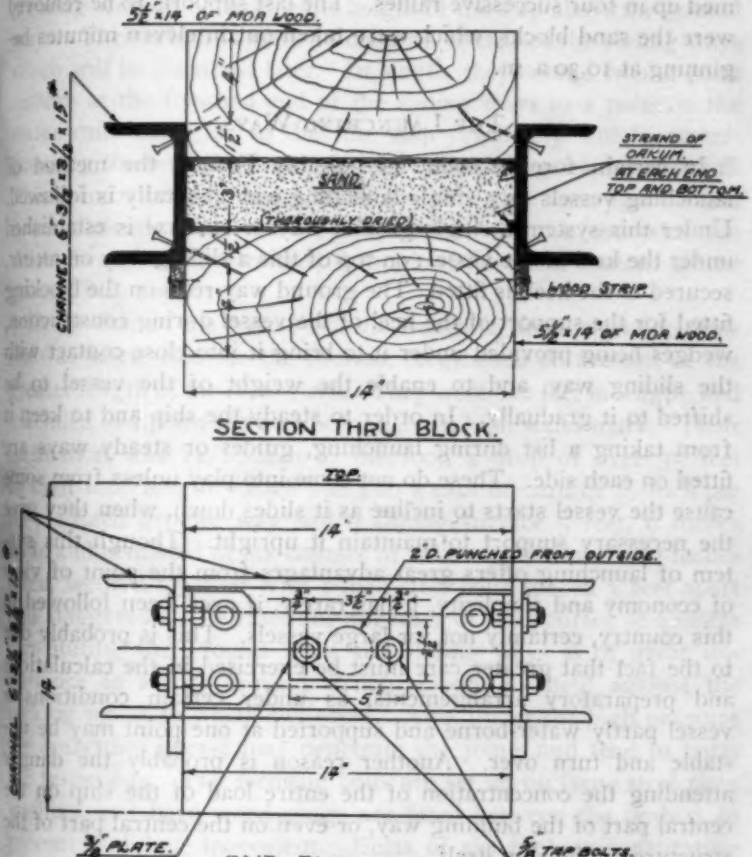


VIEW ON STARBOARD QUARTER OF "NEW YORK" THE DAY BEFORE LAUNCHING.

timbers about 20 feet long, fore and aft, and 16 feet athwartships; and a very large number of shores. These supports must be suppressed gradually, until at the time of launching of the *New York* all supports had been removed with the exception of 119 tumbling shores, which were left in place when the vessel was released. On the morning of the launching the vessel was supportd as follows:

In addition to the launching ways, tumbling shores and keel blocks there were six cribs and 24 shores. Two months prior to the launching alternate keel blocks from frames 1 to 99 had been removed and collapsible sand blocks substituted.

The advantage of these lies in the facility with which they may be removed by allowing the sand to escape. At the same time they were capable each of supporting safely a load of 125 tons. The reg-



SKETCH SHOWING ARRANGEMENT OF COLLAPSIBLE SAND BLOCKS USED UNDER THE KEEL OF THE "NEW YORK." THE BLOCKS ARE RELEASED BY REMOVING THE SAND EITHER THROUGH THE SMALL HOLE OR BY UNBOLTING THE SIDES.

ular yellow pine keel blocks which were left in place under even frames from 2 to 98 were split out the morning of the launching.

On the morning of the launch all remaining supports, except the tumbling shores, were removed progressively, in the meantime the wedges between the packing and the sliding ways being rammed up in four successive rallies. The last supports to be removed were the sand blocks, which were taken out in eleven minutes beginning at 10.30 a. m.

THE LAUNCHING WAYS.

In certain foreign countries, notably France, the method of launching vessels on a single launching way generally is followed. Under this system a single ground way or *coulisse* is established under the keel of the vessel; on top of this a sliding way or *savate*, secured to the keel, is fitted. The ground way rests on the blocking fitted for the support of the keel of the vessel during construction, wedges being provided under it to bring it into close contact with the sliding way, and to enable the weight of the vessel to be shifted to it gradually. In order to steady the ship and to keep it from taking a list during launching, guides or steady ways are fitted on each side. These do not come into play unless from some cause the vessel starts to incline as it slides down, when they give the necessary support to maintain it upright. Though this system of launching offers great advantages from the point of view of economy and simplicity, it has rarely, if ever, been followed in this country, certainly not for large vessels. This is probably due to the fact that greater care must be exercised in the calculations and preparatory arrangements, as under certain conditions a vessel partly water-borne and supported at one point may be unstable and turn over. Another reason is probably the danger attending the concentration of the entire load of the ship on the central part of the building way, or even on the central part of the structure of the ship itself.

The method used in this country and England, and adopted for the *New York*, is that of launching on two ways, one on each side of the center, the usual distance apart being one-third of the beam of the ship, though this is subject to variation to bring the ways under portions of the structure best able to withstand the pressures incident to launching a ship, and over suitable piling of the building slip. The ground ways are secured to the building slip, their upper surfaces being in a plane inclined to the horizontal at the angle determined as seen above. Sufficient space must be allowed

between the ground ways and the bottom of the ship at its lowest point to permit the sliding ways, packing and wedges to be fitted. These considerations and the clearance of the stem at and after pivoting serve to determine the height of the ship above the ground ways. Their width is made to conform to that of the sliding ways which will be discussed later. In length, they extend from a point inshore at the forward end of the sliding ways to a point in the water sufficiently far so that the ship practically will be water-borne by the time the forward end of the sliding ways passes off. This point is of importance, as if when the ship does pass off and is insufficiently water-borne, it may drop off the end with too much force and be damaged through striking the bottom or the ground way supports.

In the case of the *New York* the launching ways were the same ones as were used for the *Florida*, lengthened on account of the greater length of the *New York*. They were 620 feet in length, and extended to a point 197 feet beyond mean high water mark. Their inclination was 11/16-inch to the foot, a drop of over 35 feet in their total length. Each had also a cant inboard of ½-inch per foot. Each ground way had a sliding surface 5 feet, 6 inches wide and consisted of six courses of yellow pine timbers 12 inches thick, secured together with 1-inch steel bolts spaced 3 feet apart and staggered. The fastening together of the courses of timbers constituting the ground ways and sliding ways is of great importance to secure a rigid structure securely held against the racking forces to which subjected. Also, under the high pressure the launching grease may penetrate the joints and tend to burst the fastenings. The securing bolts are set up on large steel plate washers, and hard wood coags are fitted between the timbers to prevent a sliding movement. Butts of the timbers constituting the courses are shifted and those in the outer courses are reinforced with steel straps. A ribband of yellow pine 4-inches by 14-inches was fitted on the outer edge of each ground way to eliminate the possibility of the sliding ways leaving the ground ways. In order to hold the ground ways securely against the spreading forces brought into play, spur logs were fitted at intervals of eight feet on the outer sides of each ground way. A clearance of 2 inches to 3 inches is allowed between the ribband and the sliding ways.

The dimensions of the sliding ways are determined primarily by the length and launching weight of the vessel, although it is customary to use launching ways on hand, if they can be adapted. It has been found in practice that it is not safe to exceed certain values for the unit pressure of the sliding ways on the ground ways. If the pressure is excessive the value of the coefficient of friction becomes too great to permit launching, due to the fact that the lubricant that is used between the sliding surfaces will be forced out before the vessel can be launched, or even during the actual launching.

On recent launchings of large vessels the following unit pressures per square foot of the sliding ways obtained:

Vestal	2.14 tons
Connecticut	2.18 "
Florida	2.30 "
Wyoming	2.17 "
Arkansas	2.42 "
Utah	2.25 "
Texas	2.38 "

The pressure in the case of the *New York* was 2.39 tons to the square foot.

It is evident that it is desirable to have the sliding ways as long as possible. Due, however, to the shape of the ship it is not possible to extend them to its full length. The forward ends, or "fore-poppets," especially can extend no farther than a point where they can be so secured and fitted to the ship as to give ample support during pivoting, at which time, as has been seen, a large part of the weight is concentrated here. In way of the fore-poppets, therefore, the hull itself must be sufficiently strong, or permit being supported, so as to stand this force without deformation. The length of the sliding ways in general, is about eight-tenths the total length of the ship, in the case of the *New York* it was 437½ feet, the effective length being 426 feet, the overall length of the ship being 573 feet. Their width was 5 feet.

The length of the sliding ways having been determined, the width is determined readily by considering the launching weight of the ship, the length of the sliding ways and the unit of pressure which it is desired to obtain. In the case of the *New York*, as has been seen, the launching ways that had been used on the *Florida* were on hand, and in order to minimize the expense it was decided

to use them, after lengthening. The sliding ways were each in three sections. The two stern sections were held together by outside straps, and the third section was secured by a slip pin for convenience in removing after launching. The thickness of the sliding ways is determined to some extent by the method of release. When this is effected by sawing off sole pieces at the forward end of the sliding ways, these must be of sufficient strength to hold the ship against its force of impulsion down the ways. Another consideration is the necessity of sufficient rigidity and stiffness of the sliding ways to prevent their deformation under the wedging-up process; also safe handling in and out of water without breaking. Satisfactory compliance with the above considerations will generally give sufficient rigidity for release by a trigger as in the case of the *New York*.

The sliding ways were constructed of five courses of 12-inch yellow pine timbers, bolted with 1-inch steel bolts spaced two feet apart and staggered. The bolts were set up on steel plate washers, coaged, and the butts of the outer course of timbers were strapped with steel plates.

METHOD OF RELEASE.

As the final preparations for the launching advance, and the blocks, cribbing and shores that supported the hull during construction are removed and the weight is transferred to the launching ways, the force of impulsion which ultimately causes the vessel to slide down the ways comes into play. In order that the vessel may not get away until the appointed time and all arrangements shall have been completed, some means must be used to hold it, and at the same time to permit its being released promptly when desired. The method utilized most generally, and the one followed heretofore at the New York yard, is the expedient of extending the ground ways and oak sole pieces securely fastened to the sliding ways slightly forward of the fore-poppets, and fastening them together solidly. To release the ship the sole pieces are sawed through at the forward end of the sliding ways.

In the case of the *New York* it was decided to adopt the launching triggers, one for each side, which had been utilized previously with success in launching the sister ship, the *Texas*. The device consists of heavy steel bell cranks or triggers fitted on horizontal axes let into the ground ways. The upper arm of each of these

triggers, when upright, takes against castings set into the sliding ways. They are held in this position by hydraulic cylinders with pistons pressing against the lower arms of the triggers. The cylinders are cross connected and the pressure can be put on the pistons by means of a small hydraulic pump. By opening the escape valve the liquid in both cylinders is freed simultaneously, releasing the triggers and the sliding ways. Safety pawls are

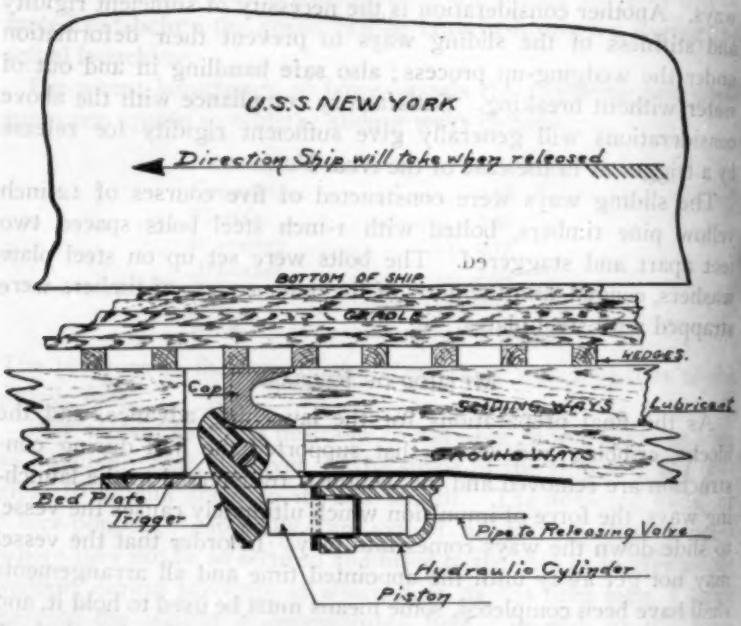
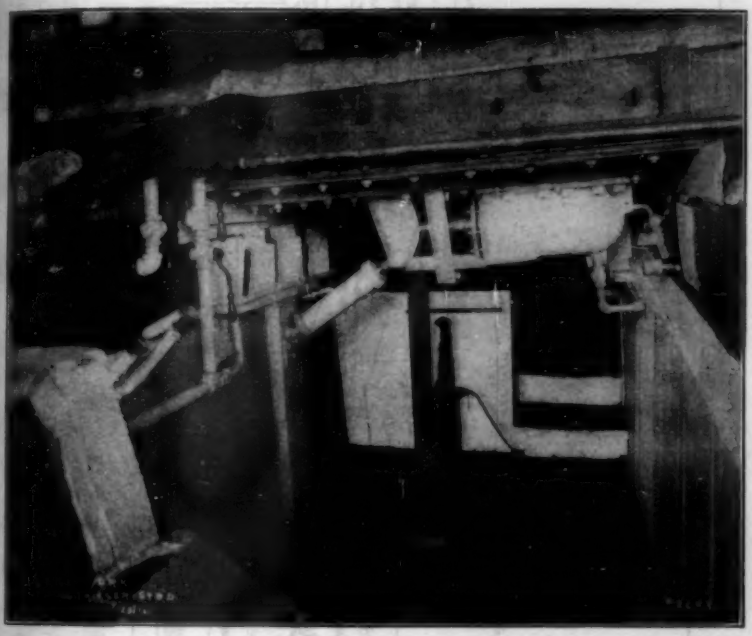


DIAGRAM SHOWING ARRANGEMENT OF HYDRAULIC RELEASING TRIGGERS, TWO OF WHICH WERE USED FOR THE "NEW YORK."

provided, which when in place prevent positively the triggers from dropping. Pressure gauges are provided to show the pressure on the interiors of the cylinders, which is an index of the force being exerted on the trigger. Before the *New York* was released this pressure went to 2000 pounds per square inch.

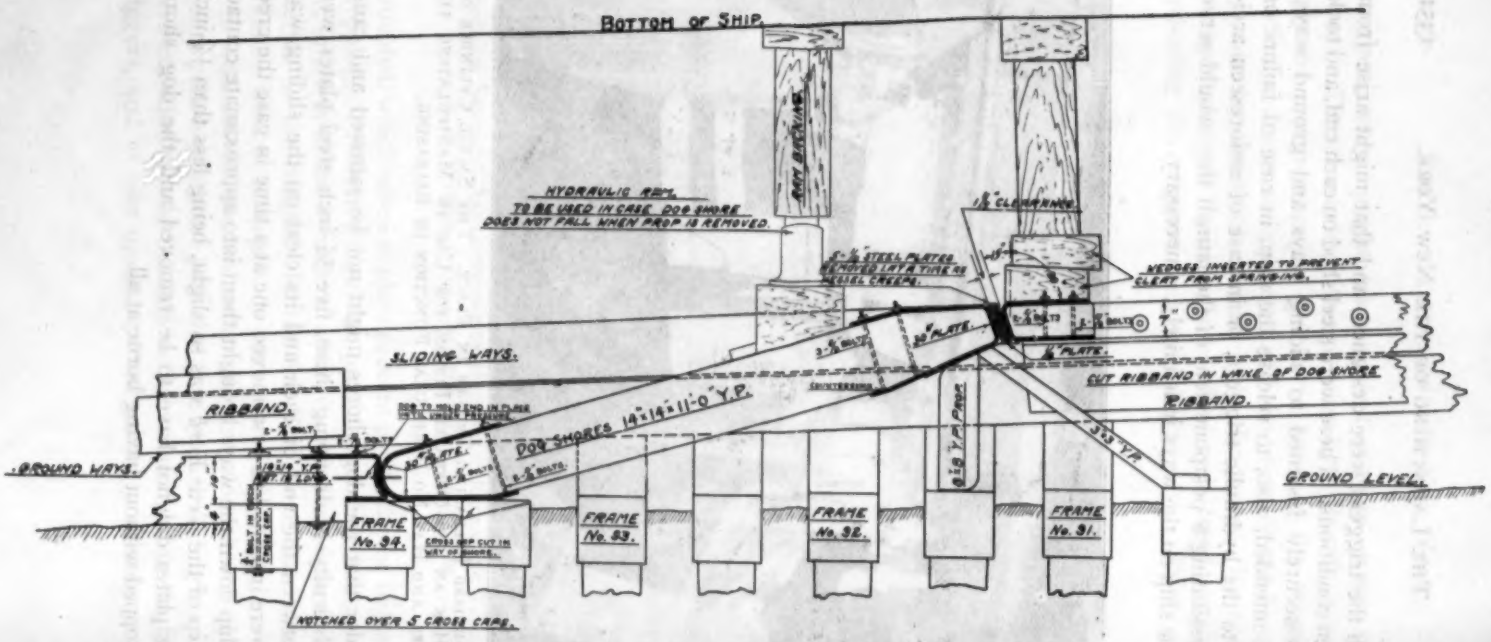
In addition to the hydraulic triggers, dog shores of 14-inch square yellow pine were provided, one on each sliding way. These were intended to hold the ship in case of accident to the hydraulic triggers, and to take up unexpected excess pressures, over those

for which the triggers were designed, and that might arise from unforeseen conditions. These were steel shod on each end, and took on cleats securely fastened to sliding ways and ground ways. They are intended, also, to release the ship, in case of failure or accident to the hydraulic triggers, or in case of unforeseen accident necessitating a postponement of the launch they would serve to hold the ship on the ways indefinitely, if necessary.



THE STARBOARD RELEASING TRIGGER IN PLACE. THE SMALL CYLINDER ON LEFT HAS AN AIR-OPERATED PISTON FOR USE IN MANIPULATING THE TRIGGERS, AND HAS NO PARTICULAR FUNCTION IN RELEASING.

In order that the dog shores might not be jammed and cause undue difficulty in dropping them, five ¼-inch steel plates were fitted between the end of each and its cleat on the sliding way. These were intended to be removed one at a time in case the creep of the ship down the ways brought them into approximate contact. The creep of the *New York* was so slight, being less than ¼-inch, that the plates did not have to be removed and the dog shores were dropped without having borne at all.


BOTTOM OF SHIP.
HYDRAULIC RAM, TO BE USED IN CASE DOG SHORE DOES NOT FALL WHEN PROP IS REMOVED.
1/8" CLEARANCE.
WEDGES INSERTED TO PREVENT CLEAT FROM SPRINGING.
SLIDING WAYS.
RIBBAND.
GROUND WAYS.
DOG SHORES 14"x14"x11'-0" Y.P.
CUT RIBBAND IN WAKE OF DOG SHORE.
GROUND LEVEL.
FRAME No. 94.
FRAME No. 93.
FRAME No. 92.
FRAME No. 91.
NOTCHED OVER S. CROSS CAPS.

ELEVATION; LOOKING INBOARD.

DIAGRAM SHOWING ARRANGEMENT OF DOG SHORES, TWO OF WHICH WERE USED PRECAUTIONARILY ON THE "NEW YORK."

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It frequently occurs that due to the initial friction of the grease or the holding effect of the tumbling shores, a vessel does not start when released. In order to give it initial motion four hydraulic rams were provided, two of 150 tons power and two of 100 tons. These were placed at the forward end of the ways taking against a backing log bolted to the ground ways, and a cross timber bearing directly on the ends of the sliding ways. The *New York* started at once when released and no use was made of the starting rams.

THE LUBRICANT.

The question of a proper lubricant between the sliding surfaces is of great importance, as on it depends largely the success of the launching. If it is too soft it will be forced out by the pressure, or if too hard the coefficient of friction will be unduly increased. In determining the degree of hardness of the grease, consideration must be given obviously to the unit pressure and the probable temperature of the air the day of the launch. The lubricant was applied in a total thickness of about 5/8-inch. Beef tallow was the principal ingredient, the others being stearine and launching grease. The launching grease is softer and is intended to give the initial lubrication, until the harder tallow melts under the friction. Lard oil was poured in the openings left by the separators just before the launch, also, to aid in giving initial lubrication. It had been customary at prior launchings at the New York yard to fit the launching ways completely in place, providing means for removing the sliding ways with their packing to permit applying the grease just prior to the launching. In the case of the *New York* it was decided to apply the grease when the ways were first installed, which covered a period from September 15 to October 15, 1911. To protect the grease during this period from being squeezed out, steel separators 5/8-inch thick were fitted between the sliding ways and ground ways, at intervals of ten feet. These were removed the day before the launch. Separators were also used with the former method. To prevent dirt from entering the space between the ribbands on the ground ways and the edge of the sliding ways, strips were nailed along. These, too, were removed the morning of the launch. In order to hold the sliding ways in their proper position laterally, with respect to the ground ways, thumb toggles are used. These consist of blocks

DIAGRAM SHOWING ARRANGEMENT OF DOG SHORES, TWO OF WHICH WERE USED PRECAUTIONARILY ON THE "NEW YORK."

of oak 2½-inches in width inserted between the outer sides of the sliding ways and the ribbands on the ground ways.

In order to grease the submerged portion of the ground ways for a distance of about 30 feet below low water mark, two coffer-dams were used, one on each way, which permitted exposing a section on each of 30 feet in length. An oil torch was used to dry the wood prior to the application of the grease, which was made the two days preceding the launch. Grease distributers, also, were provided, consisting of boxes, one at the end of each sliding way, filled with grease and provided with a weighted piston to force it out as the ship moved down the ways. These were fitted to provide lubricant for the remaining ungreased portion of the under-water ground ways.

FORE AND AFTER POPPETS AND PACKING.

Due to the form of the ship, and the necessity for extending the ways the maximum length possible, it is necessary to introduce a considerable amount of wood or packing between the upper surfaces of the sliding ways and the hull of the ship. This must be solidly fitted so as to give firm support to the ship, and must be carefully adjusted to the shape of the hull to distribute evenly the weight. Over the central portion the packing for the *New York* consisted for the most part of 4-inch by 12-inch yellow pine planks planed carefully to uniform thickness and piled in a manner similar to brick work, about 200,000 board feet of lumber being used. At the forward and after ends, where more packing was needed, yellow pine timbers 12 inches square were used. The packing on each side was in three sections, exclusive of the "fore-poppets." It was separated from the sliding ways by oak wedges eight feet long and six inches square at the base, spaced 14 inches apart. These were depended on to bring the packing tight against the hull, and by taking its weight at least partly, to aid the removal of building supports. One hundred and thirty four-handed battering rams of live oak 6½ feet long and 6 inches square were provided to drive the wedges, which were rammed up in four rallies, each extending six minutes.

At the forward and after ends of the ship, due to its wedge shape, there is a spreading force on the ways which is met by lashings securing the poppets on each side together. The after-poppets on the *New York* were secured by four lashings of 10-

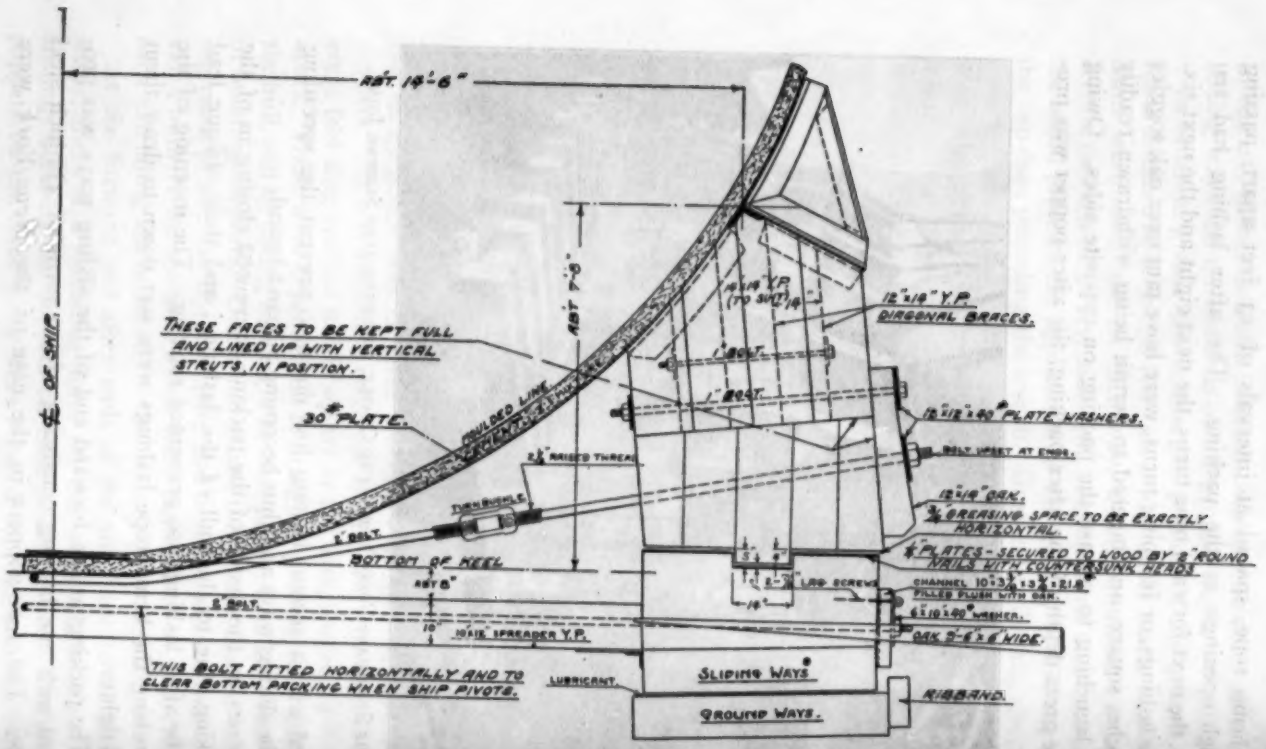
inch hemp rope, spaced at intervals of 13 feet apart, passing through openings in the packing. The after lashing had ten turns, the next forward nine turns, the next eight and the next six. These lashings, or frapping turns, were hove taut over oak toggles 14 inches square, and tapered to permit being withdrawn readily after launching to release the packing on opposite sides. Owing to the great depth of the after packing, the after-poppet was pro-

THE STARBOARD FORE-POPPET AND CRADLE, SHOWING ALSO SLIDING JOINT.

vided with a second lashing low down to prevent the spreading of the sliding ways and thus becoming ribband-bound.

Struts on the inside of the packing prevented closing in of the packing, due to the pull of the lashings, and their oblique lead at the after lashing also prevented racking. The morning of the launching the hemp rope lashings were wet down to draw them still tighter.

The packing at the forward end of the sliding ways was provided with one lashing consisting of ten turns of 3½-inch steel rope. The fore-poppets in the case of the *New York* were

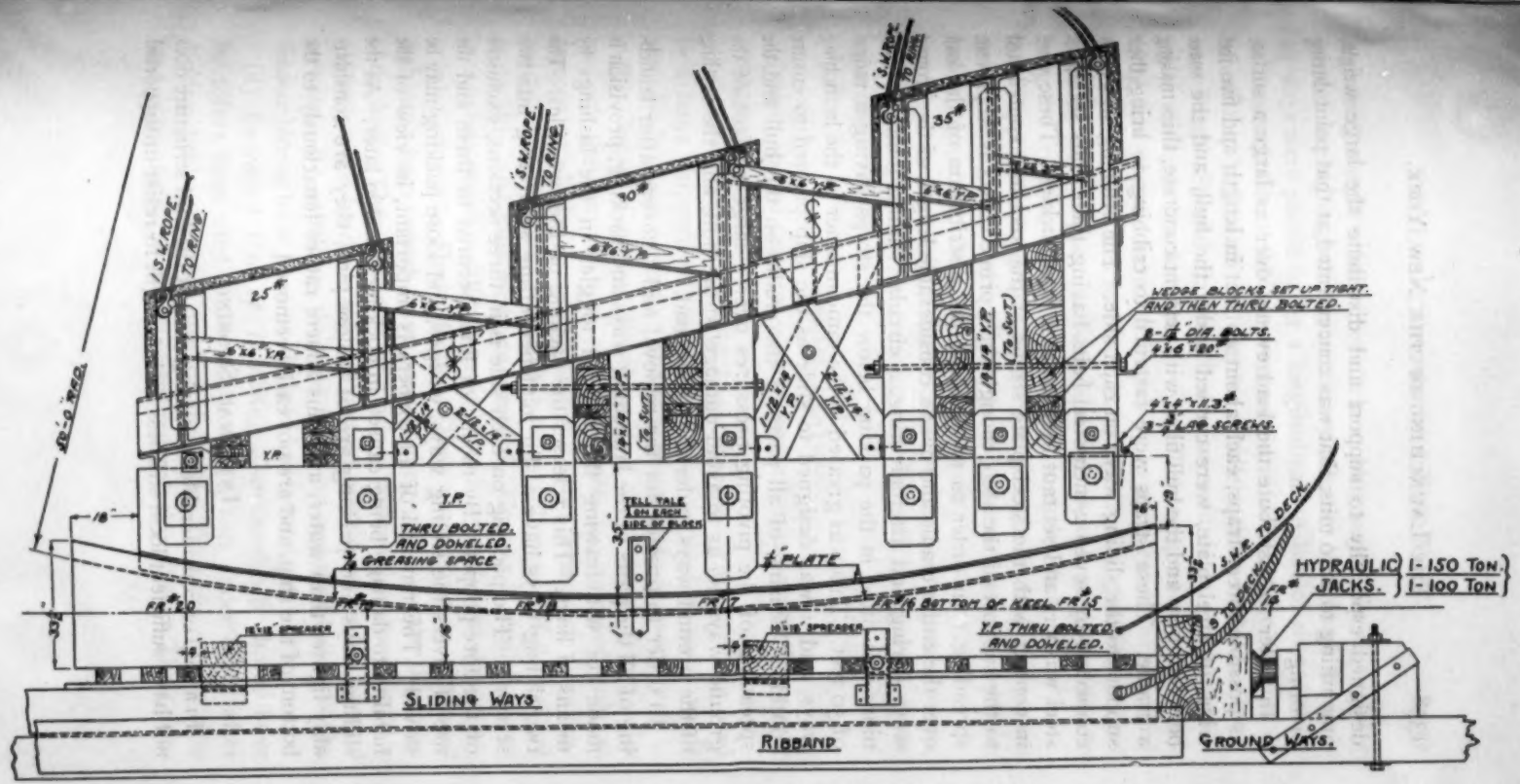


SECTION AT FRAME. No 17.

CROSS SECTION SHOWING ARRANGEMENT OF FORE-POPPET AND CRADLE, ONE SIDE ONLY SHOWN.

SECTION AT FRAME. Nº 17.

CROSS SECTION SHOWING ARRANGEMENT OF FORE-POPPET AND CRADLE, ONE SIDE ONLY SHOWN.



VIEW OF FORE-POPPET AND CRADLE FROM OUTSIDE. CURVED LINE SHOWS THE SLIDING JOINT ARRANGED FOR PIVOTING.

designed especially to support and distribute the large weight, amounting to 2110 tons, that was concentrated at that point during pivoting.

In order to distribute the load evenly over as large a surface as possible three straps, each about 40 feet in length and five feet wide, of steel plate, were carried under the hull, and the space between them and the hull filled with cement concrete, thus making a cradle. These straps were fastened to cribbing to bring their support to the sliding ways on each side. The cribbing was cross connected by seven 2-inch steel bolts having their ends set up on steel washers and set taut by means of turn buckles. These were in contact with the steel plate straps at the keel and contributed to the support of the ship, though their prime object is to prevent spreading. In order to provide for the distribution of the load over the entire cradle and over a considerable length of the ground ways during and after pivoting, a circular sliding joint, or trunnion, was fitted in the packing below the straps having a radius of 50 feet. This was greased in the same manner as the launching ways, and it was designed to slide as the ship pivoted to ensure continued bearing of all parts of the cradle on the hull and the spreading of the pivoting pressures over a large surface of the ground ways, so as to avoid damage to the hull, and the settling of the ground ways under the heavy load.

In order to provide for the removal and recovery after launching of all the parts of the launching ways and packing, provision is made for withdrawing the tapered toggles in the lashings by means of lines. This releases the packing on the two sides. The two sliding ways have a slip joint permitting separating into two sections. The packing on each side is in three sections, exclusive of the fore-poppet. By means of lines secured to them and the use of divers the sliding ways, wedges, and loose packing may be salved. The removal of all timbers is important, in view of the liability to damage being caused in docking the ship later, As the sliding ways and packing are of yellow pine, they are considerably lighter than water, and thus adhere rather tenaciously to the bottom of the ship, and are not easily removed.

INTERNAL SHORING.

In a ship of considerable launching weight the hull structure does not have sufficient local stiffness and strength to resist unsupported

the forces brought to bear over the launching ways. For this reason internal shoring is generally necessary. On the *New York* the sliding ways were placed under a longitudinal. A line of shores were fitted on each side of this between outer and inner bottom. In way of athwartship bulkheads and between boilers three rows of shores were fitted. Special diagonal braces were fitted in certain localities to reinforce bracket floors. Special shoring was fitted in way of the fore-poppets between frames 15 to 20 to resist the crushing forces exerted by the fore-poppet cradle during pivoting. This extended to the upper platform and was cross-braced securely to bring the crushing forces in opposition to each other.

To support the long span between bulkheads in the boiler rooms heavy shoring was carried from the top of inner bottom, between boilers, upward to the armor and gun decks.

All boilers were in place, also considerable auxiliary machinery, and all the shafting from the thrust shaft aft; a total of about 750 tons.

SPECIAL FEATURES.

Certain special features were comprised in the above launching arrangements as follows:

(a) *The Trunnion Type of Fore-Poppets.*—This has been used by a large shipyard in this country, and is used in some yards abroad—It is not expensive and is believed to do its work well.

(b) *Cement Concrete Between Hull and Poppet Straps.*—Its use with the trunnion type of fore-poppets is particularly advantageous, as all the straps are brought up to their work simultaneously. The ship was greased to prevent adherence of the cement to the ship, and thus facilitate removal. Cement is easily poured in, whereas wood is difficult to fit behind a 5 to 6-foot strap.

(c) *Collapsible Keel Blocks.*—These should not be confused with sand bags, which have poor holding power in the direction of the keel. They consisted of a 6-inch channel bar frame with a 5½-inch wood block on top and bottom, with three inches of sand between. By unbolting, the sand flows out and the block is loose. Similar blocks have been used abroad to some extent.

(d) *Extended Use of Tumbling Shores.*—Such shores have heretofore been used under the keel aft, and under inner after docking keels. In the case of the *New York* they were also used under the entire length of the outer docking keel. Their prin-

cipal function is to guard against the grease being squeezed out before the moment of release. They operated in an entirely satisfactory manner. For some time before launching they served the ordinary purpose of supporting the ship.

(e) *Grease Box at End of Ways.*—This was also used when the *Flordia* was launched. It has not been customary at the New York yard to grease the ground ways under water to the extreme end, and the grease box is intended to do this. It costs little and it has been thought well to take this precaution.

WORKMEN EMPLOYED.

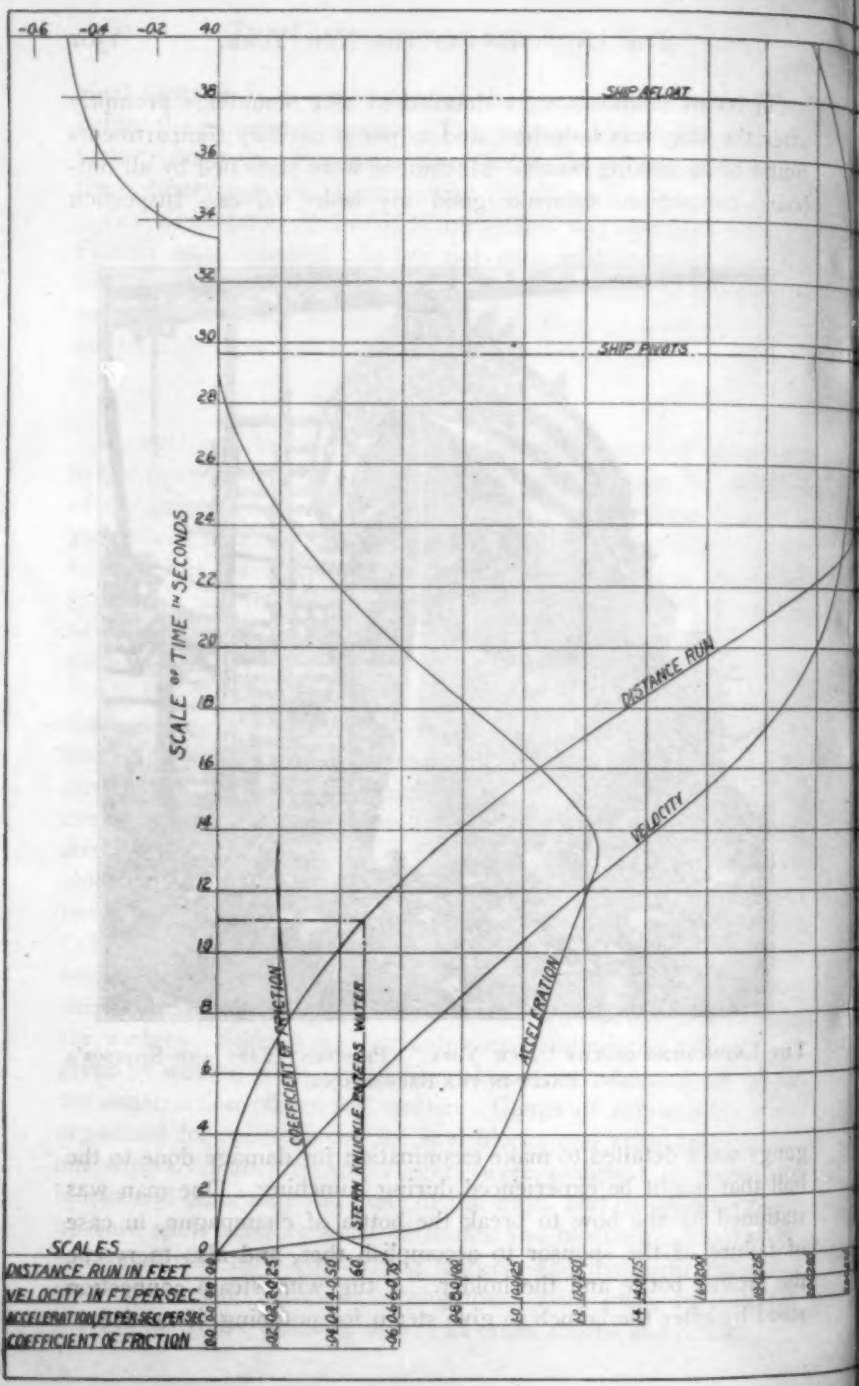
Launching a large vessel is of sufficiently unusual occurrance in the navy yard to require the special organization and training of the gangs for each launching. During a launching in a navy yard there is no economy in reducing the number of workmen employed as the navy yard closes for the day and all workmen are given full pay in any event, so that as many as can be used to advantage are employed. A detailed station bill was prepared for each man to be employed in the launching operations of the *New York,* and they were given buttons to permit them to pass inside the lines, and to distinguish them from other workmen not actually employed. The general conduct of the launching was under the direct charge of the construction officer, assisted by the naval constructor charged with the immediate supervision of the construction of the ship. A naval constructor was in immediate charge of the gangs on the ground on each side of the ship, and two were on board.

The force for ramming up the wedges consisted of about five hundred men, principally shipfitters and helpers, riveters and chippers; each gang containing four men was assigned to ram up six wedges. Signals for beginning and ending the rallies were given by waving white or red flags abreast the releasing pit where the construction officer had station. Gangs of shipwrights were organized for splitting out the keel blocks and cribs and cutting out shores. Laborers and riggers were assigned to move the blocks and other material clear of the ways, and painters to touch up bare spots after removal of shores and blocking. Machinists were stationed by the launching triggers and hydraulic rams for starting the ship. Details of shipfitters were made to look for holes or defective caulking in way of cribs, shores and blocks.

On board plumbers were detailed to take soundings promptly after the ship was launched, and to pump out any compartments found to be making water. Machinists were stationed by all outboard connections to make good any leaky valves. Inspection

THE LAUNCHING OF THE "NEW YORK." PRESIDENT TAFT AND SPONSOR'S PARTY IN THE BACKGROUND.

gangs were detailed to make examination for damage done to the hull that might be experienced during launching. One man was stationed by the bow to break the bottle of champagne, in case of failure of the sponsor to accomplish that, and also to rescue the broken bottle and the holder. A tug with steam connection stood by after the launch to give steam for pumping, if needed.



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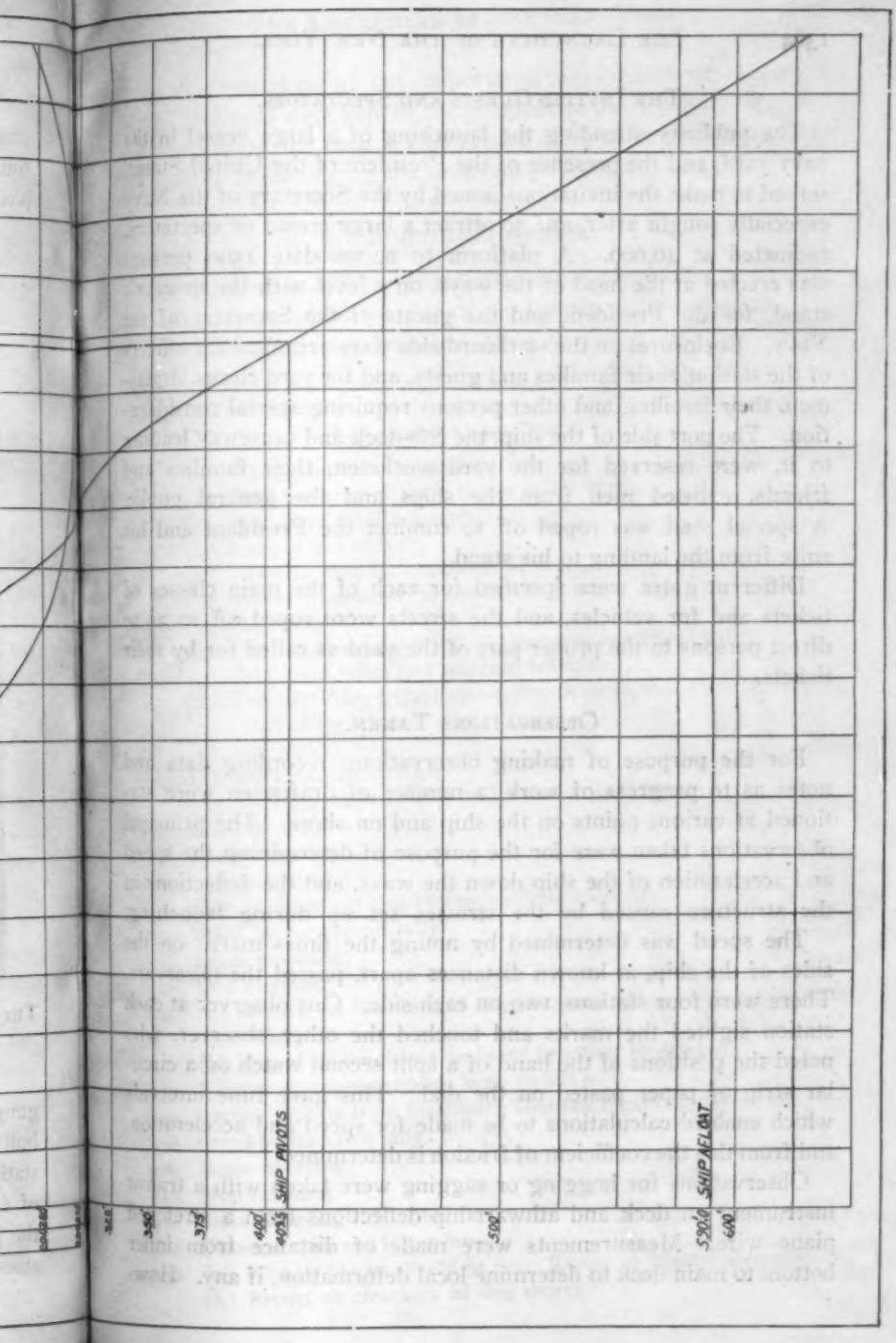


G COEFFICIE[NT] OF SLIDING SURFACES, AND CURVE OF COEFFICIENT OF FRICTION DEDUCED.

THE INVITED GUESTS AND SPECTATORS.

The publicity attending the launching of a large vessel in the navy yard, and the presence of the President of the United States, served to make the invitations issued by the Secretary of the Navy especially sought after, and to attract a large crowd of spectators, estimated at 40,000. A platform to accomodate 1500 persons was erected at the head of the ways, on a level with the sponsor's stand, for the President and the guests of the Secretary of the Navy. Enclosures on the starboard side were arranged for officers of the station, their families and guests, and for yard clerks, draftsmen, their families, and other persons requiring special consideration. The port side of the ship, the cob-dock and causeway leading to it, were reserved for the yard workmen, their families and friends, enlisted men from the ships and the general public. A special road was roped off to conduct the President and his suite from the landing to his stand.

Different gates were specified for each of the main classes of tickets and for vehicles, and the streets were roped off so as to direct persons to the proper part of the yard as called for by their tickets.

OBSERVATIONS TAKEN.

For the purpose of making observations, recording data and notes as to progress of work, a number of draftsmen were stationed at various points on the ship and on shore. The principal observations taken were for the purpose of determining the speed and acceleration of the ship down the ways, and the deflections in the structure caused by the stresses set up during launching.

The speed was determined by noting the times marks on the sides of the ship, at known distances apart, passed the observers. There were four stations, two on each side. One observer at each station sighted the marks and touched the other observer, who noted the positions of the hand of a split second watch on a circular strip of paper pasted on the dial. This gave time intervals which enabled calculations to be made for speed and acceleration, and from this the coefficient of friction is determined.

Observations for hogging or sagging were taken with a transit instrument on deck and athwartship deflections from a stretched piano wire. Measurements were made of distance from inner bottom to main deck to determine local deformation, if any. How-

ever, no deflections of any importance were noted on the *New York*. Records were kept of the progress of the operations and the time consumed for each. This record is of value for subsequent launchings in making up the program.

LAUNCHING PROGRAM.

The various launching operations were previously scheduled and were executed on the day of the launch as per schedule.

The *New York* was launched at 11:00:30 a. m., October 30, 1912.

SCHEDULE OF TIME.

4.30 Early launching gang reports.
- (a) Final greasing of ways to low-water mark.
- (b) Wet down manila frapping aft.
- (c) Remove dirt strips.
- (d) Diver to examine condition of ways.
- (e) Report from diver on condition of ways.

7.45 All officers report.

8.00 (a) Full launching gang and all observers report for duty.
- (b) Test voice tubes and warning whistle.
- (c) Test launching trigger and hydraulic rams, then close space over launching trigger.
- (d) Set clocks.
- (e) Start pouring lard oil.
- (f) Set creeping indicators and trunnion indicators.

8.18 Stand by for first rally.

8.20 Begin ramming.

8.26 Stop ramming.

8.27 Start splitting out keel blocks, working from aft.

8.33 Stand by for second rally.

8.35 Begin ramming.

8.41 Stop ramming.

8.42 (a) Reports on clearance of dog shores by officer in charge on each side.
- (b) Report of conditions on board by officer in charge.

8.43 Remove shores under bilge keels (white).

8.45 Receive reports from Machinery Division regarding valves, etc.

8.58 Stand by for third rally.

9.00 Begin ramming.

9.06 Stop ramming.

9.10 Start removing side cribs.

9.15 Disconnect air and water lines.

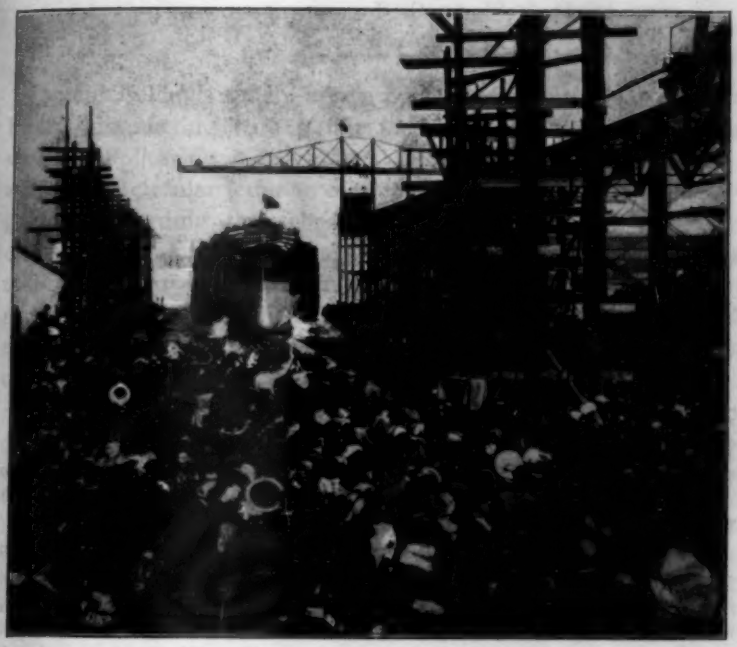
9.30 (a) All keel blocks should be out. Report by Master Shipwright.
- (b) Report on clearance of dog shores.

9.58 Stand by for fourth rally.
10.00 Begin ramming.
10.06 Stop ramming
10.08 (a) Remove ramming shores between ways.
(b) Side cribs should be out.
(c) Clear away stage plank in way of tumbling shores under docking keels where inaccessible.
10.12 Report on tide.
10.15 Begin removing sand blocks, beginning aft (this was actually begun at 10.30).
10.20 Disconnect electric lines to ship.
10.25 Receive report from ship that air ports, manholes, doors, etc., are closed and everything ready on board.
10.30 Report all thumb toggles out by officers in charge on each side.
10.35 Disconnect speaking tube on board.
10.40 (a) Hoist warning signal to river.
(b) Remove gang plank.
10.45 Trigger and hydraulic pump men to stand by.
10.50 (a) Sand blocks should be out.
(b) Stand by to remove docking keel tumbling shores in case this becomes necessary.
(c) Reports that everything is clear of ship by officers in charge on each side.
(d) Report on tide.
10.55 Report on clearance of dog shores.
10.56 Warning whistle:
1 blast—stand clear. (This is also warning to sponsor.)
10.57 Report all men out by officers in charge on each side.
10.58 Warning whistle:
2 blasts—drop dog shores.
10.59 Report dog shores out by officers in charge on each side. (Personal report.)
11.00 Release ship by Naval Constructor in charge.

"ON BOARD"—OUTLINE OF ORDERS, ETC.

8.00 All men report for duty.
8.05 Test voice tube to releasing pit.
8.06 Make personal inspection of ship as to condition, lines, collision mats, leak stoppers, etc.
8.15 Receive reports from foremen on board regarding men, tools, etc.
8.16 Order inspection of inner bottom compartments and closing of manholes.
Order all air ports and doors closed.
Order all hatches ready to batten down.
8.42 Report condition on board.
9.15 Disconnect air lines.
10.00 Receive report on soundings from Master Plumber.

10.20 Disconnect electric lines.
10.25 Report that all doors, air ports, etc., closed and that all is ready on board.
10.35 Disconnect speaking tube.
10.40 Remove gang plank.
10.45 See that man is stationed at bottle line; see that men are stationed at lines and at anchors.
11.15 Receive report on soundings with copy of report from Master Plumber.



LAUNCHING OF THE "NEW YORK."

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVAL DISCIPLINE.

By CAPTAIN CHARLES F. POND, U. S. Navy.

Captain Fullam's timely article on "Absence Overleave in the Fleet"[1] is meeting with a fair measure of response from the service. Following it, the Navy Department in February last, addressed a circular letter to commanding officers requesting suggestions regarding the schedule of punishments for summary courts martial and deck courts, as laid down on page 185, "Forms of Procedure, 1910." The following is the substance of my remarks submitted in obedience to the above-mentioned request, and now, with the Department's permission, laid before the readers of the PROCEEDINGS for their consideration:

1. The schedule for punishments for summary courts-martial and deck courts laid down on page 185 of "Forms of Procedure, 1910," is in my opinion excellent and should be adhered to. It has been very consistently followed on this ship, the U. S. S. *Pennsylvania*, with excellent results.

2. The one criticism that I have to make is that it is not complete in that no provision is made for absence overleave for less than twenty-four hours, and that the offenses, "petty theft," "having the articles of another in possession" (a rather common offense), "selling, bartering, exchanging, pledging, loaning, or giving away any portion of uniform or outfit" (see Article 204, U. S. Navy Regulations) and also another common offense, "careless or willful loss of government property," and "profane language," are omitted. The latter I would include under the next to the last offense cited, making it read "threatening, abusive, profane and obscene language," For "petty theft," "having articles of another in possession," "selling, bartering, etc., portion of uniform or outfit," and "willful destruction of government property," the maximum days' loss of pay should be awarded, it being understood that for these offenses, and others where different degrees of criminality attach, the court should use discretion in awarding sentence. Such offenses should be marked on the scedule wth an awarding and a note appended to the above effect. For "loss or destruction of government property by carelessness," loss of pay to cover value, ordin-

[1] U. S. Naval Institute Proceedings, volume No. 37, No. 4, 1911.

arily the invoice price, should be adjudged not to exceed the maximum allowed by law. This is in line with recent regulations concerning the custody and care of government property and will have an excellent effect besides tending toward economy.

3. To the schedule of punishments there should also be added regulations regarding liberty for which there is crying need of uniformity throughout the service. I cannot too strongly urge this point.

4. Forwarded herewith is a proposed schedule of punishments and regulations regarding liberty now in force on this ship and which is practically the same as the one which has been in force on this ship during the past three years under my command. Under this schedule no such condition has obtained as described by Captain Fullam and other officers as being common among the ships of the Atlantic Fleet. While offenses have not ceased, and under any system will never cease entirely, there has been a steady and marked improvement in the conduct of the crew and many cases of complete reformation. As showing the excellent standing of the crew of this ship the following summary of conduct classes on the first of the present month speaks for itself:

Special first class	275
First class	204
Second class	3
Third class	11
Fourth class	12

5. Analyzing the appended schedule:

Paragraph 1 is similar in effect to the note at the bottom of page 185, "Forms of Procedure, 1910." On a schedule emanating from the Department the wording of the above mentioned note should be followed. Confinement is a degrading punishment and should not ordinarily be adjudged. Other minor reasons against confinement as a mode of punishment are lack of cells on modern ships and the useless labor involved in guarding and policing prisoners. When adjudged, the rule of one to three implied in Article 30 of "Articles for the Government of the Navy" should be followed, viz., one day's confinement for each three days' loss of pay.

Paragraph 2 begins with providing for absence overleave for less than twenty-four hours and follows the spirit of the schedule for longer absences except that the loss of five days' pay for the offense is omitted. The result is that for a first offense of short absence a minor punishment is awarded. For repeated offenses of this character the cumulative provision of paragraph 5 comes in with good effect which would be in a measure lost were the five days' loss of pay adjudged for each minor absence in addition to the one, two or three days' pay laid down in the schedule. A man habitually overleave for but a few hours, but who, for the fourth and subsequent offense, gets a checkage of twenty days' pay is apt to begin thinking and correct his habits. This has been the experience on this ship. It is also believed that a sharp line should be drawn between absence for less than twenty-four hours and longer absences, and this the schedule does. Absence of less than one hour, or tardiness, is infre-

quent and is generally checked by reproof or slight restriction. In awarding punishment at the mast the man's record should always be consulted, and, where the offense with previous record considered would not warrant a punishment exceeding twenty days' loss of pay, a deck court should be awarded for simplicity of procedure; where the punishment with previous record considered would exceed twenty days' loss of pay a summary court-martial should be adjudged.

Paragraph 3 follows the schedule as laid down on page 185, "Forms of Procedure," with the additions heretofore noted. A save-all clause is added covering less serious but not petty offenses for which summary punishment may be given by the commanding officer in the shape of solitary confinement on bread and water not exceeding five days. Any other confinement except for safe keeping, etc., is obsolete or obsolescent.

Paragraph 4 provides for the reduction to fourth conduct class of any man convicted before a deck court or summary court-martial of any offense save overleave for less than twenty-four hours, or who has been awarded confinement as a punishment. Except in special cases men on this ship are not otherwise reduced in class, except from special first to first in accordance with navy regulations. In consequence we have practically what is known as "the free gangway." Restriction is seldom awarded as a punishment except where it is considered better for a man's health or morals that he should remain on board, and a man overleave less than twenty-four hours may go ashore the day after his fine is paid; provided, it is his turn to go. The result of the application of this rule has been excellent and the Department might well consider appending an advisory clause to that effect to the schedule and regulations when revised and reissued.

Paragraphs 5 and 6 provide for cumulative punishments for previous offenses, and, in this connection, special attention is invited to the rule laid down in paragraph 6 for treatment by summary courts-martial of previous convictions in cases which would not have come under the cognizance of a summary court. Paragraph 5 follows the procedure of the schedule of punishments issued by the Department in 1908 and the two rules together appear to fully cover the suggestion in the 5th paragraph of the Department's letter, viz: "Whether there should be any different rule, with respect to convictions, if the earlier trials were had before a summary court-martial or before a deck court," These rules have been in successful practice on this ship since the 1910 schedule was issued.

Paragraph 7 provides for petty offenses and prescribes the manner in which extra duty shall be performed. As a commanding officer for a period covering over thirteen years of service, I have consistently discouraged the bringing of petty offenses to the mast, but there are certain occasions when such offenses must be considered. Such offenses should be punished by extra duty and rarely by restriction and the extra duty should be such as not to degrade the ordinary work of the ship, even the menial work, and should be worked off outside of working hours. The time limit should also be explicit. Seventy-two hours or three days extra duty generally means nothing definite and is generally mostly shirked, even

when the master-at-arms endeavors to be conscientious. The scheme provided appears to meet every requirement. Four hours extra duty carries over into the second night, and rarely is a heavier punishment than that required. The provisions for doubling extra duty for offenses committed while undergoing extra duty and for repeated offenses of the same character are extremely salutary, the latter tending to correct bad habits, such as "articles in lucky bag," "ditty box adrift," etc.

Paragraph 8 gives notice to the crew that long restrictions will not be enforced except under certain necessary circumstances.

Paragraph 9 gives the general regulations regarding liberty: These are very liberal and are believed to be consistent with the best practice. They have given perfect satisfaction on this ship to both officers and men, and it is earnestly suggested that these, or similar uniform rules, be issued for the guidance of the service. Uniformity of privileges should go with uniformity of punishments and both together will go far toward perfecting contentment among the enlisted personnel. The personal equation can never be eliminated, nor is it desirable that it should be, but that there should be uniformity as near as may be, of privileges and punishments as well as of organization and routine, which latter has been practically achieved, cannot be successfully controverted.

6. It is believed that there is nothing in the foregoing to conflict with existing laws.

GENERAL REGULATIONS REGARDING PUNISHMENTS AND LIBERTY.
U. S. S. "PENNSYLVANIA."

1. Summary courts-martial and deck courts will be guided by the following schedule in awarding punishments:

In awarding loss of pay the limit should ordinarily be adjusted, but, for those offenses marked with an asterisk (*) the degree of criminality should be considered in awarding the sentence. Confinement of any kind will be awarded only in exceptional cases and in any case should not exceed one-third the number of days for which loss of pay is adjudged.

The foregoing simply expresses the mind of the commanding officer as revising authority and is not intended to limit the power of the courts as laid down by law:

2. Over staying liberty:

Not over 1 hour	Warned, or for repeated offenses, 1 week's restriction or 3 hours extra duty.
1 to 8 hours	Deck court limit loss of 1 day's pay.
8 to 16 hours	Deck court limit loss of 2 days' pay.
16 to 24 hours	Deck court limit loss of 3 days' pay.
1 to 4 days	Deck court or summary court martial depending on record. Limit loss of 5 days' pay for the offense and of 4 days' pay for each day and 1, 2 or 3 days' pay for each additional fraction thereof absent.

More than 4 days	Summary court-martial.	Same limit as above.
Absence or attempted absence without leave	Summary court-martial.	Limit loss of 15 days' pay for offense and same as above for time absent.
Absence without leave using another's name to avoid draft.	Summary court-martial.	Limit 30 days' loss of pay for the offense and same as above for time absent.

If delivered after absence with or without leave add 5 days' loss of pay to above.

Twenty-four hours or more overtime, or absence without leave involves loss of pay for the time so absent, exclusive of the amount forfeited by sentence of court.

3. The following offenses subject the offenders to trial by summary court-martial or by deck court:

Offense.	Number of days loss of pay.
Disobedience, deliberate	Maximum.
*Disorderly conduct	15
*Disrespect to commissioned or warrant officer	Maximum.
*Disrespect to petty officer	60
Drunk, not having been on liberty	30
Drunk, on duty, post or guard	Maximum.
*Failure to obey	Maximum.
*Falsehood	Maximum.
Gambling	30
*Having articles of another in possession	Maximum.
Leaving post or watch	Maximum.
Liquor unlawfully in possession	15
*Loss or destruction of government property through carelessness.	Loss of pay to cover value up to maximum.
Missing ship after absence with or without leave	30
*Neglect of duty	Maximum.
*Petty theft	Maximum.
Resisting arrest	30
Returning from liberty unfit for the proper performance of duty.	3
Returning in civilian clothes	10
*Selling, bartering, exchanging, loaning, or giving away portion of uniform or outfit.	Maximum.
Sitting down on post or watch	15
Smuggling or attempting to smuggle liquor	15
Surrendering at another station	30
*Threatening, abusive, profane or obscene language	Maximum.
Willful destruction of government property	Maximum.

Other less serious offenses may be punished by solitary confinement on bread and water not to exceed five days.

4. Conviction by deck court or summary court-martial, except for overleave not exceeding twenty-four hours, or confinement of any kind, except for safe keeping or awaiting investigation, carries with it reduction to fourth conduct class from date of offense.

In general men will not otherwise be reduced in conduct class except from special first class to first class in accordance with navy regulations.

5. Before a deck court each previous conviction during current enlistment including for overstaying leave for less than twenty-four hours, involves an additional loss of 5 days' pay.

6. Summary courts-martial will not take cognizance of previous convictions by deck courts for overleave for less than twenty-four hours, but other previous convictions will be treated as follows:

In case of a second conviction for a case of a similar nature the punishment will be doubled, and for a third or subsequent conviction, either the maximum or a bad conduct discharge will be adjudged. If the offense is of a different character increase by 15 days' loss of pay.

7. For petty offenses extra duty will be awarded and for offenses committed while undergoing extra duty and for repeated offenses of the same character double the usual punishment will be awarded.

Extra duty will consist of duty on the quarterdeck under arms between the hours of 8.00 and 11.00 p. m.

Extra duty will be worked off as rapidly as weather and other circumstances will permit.

Men on extra duty list or on report awaiting mast or investigation, or in debt as the result of punishment, or prisoners at large will not be granted liberty except under special circumstances.

8. No person will be deprived of liberty on shore for more than two months, except in case of confinement by sentence of court-martial or when awaiting trial, or unless the exigencies of the service or the unhealthiness of the port prevents giving liberty.

9. Conditions permitting, and for stay in port not exceeding thirty days, general liberty will be granted as follows:

Special first class	Every other day.
First class	Every fourth day.
Second class	Once in two weeks.
Third class	Once in three weeks.
Fourth class	Once a month.

Under special circumstances chief petty officers, special first class, may be granted liberty each day after working hours.

When stay in port exceeds thirty days' liberty for special first class may be reduced to every fourth day (liberty by sections), with such special privileges for chief petty officers as may be expedient.

About the time the foregoing was written the Department authorized senior officers present, upon request of commanding

officers, to discharge as undesirable not exceeding one per cent of the crew each quarter, providing the men so discharged were in their first enlistment. Had this authorization been in effect at the time I assumed command of the U. S. S. *Pennsylvania*, in July, 1909, I would gladly have availed myself of it to have weeded out a certain undesirable element among the crew, but coming at the time it did, after the above system had been in force for nearly three years, there was little occasion for its use. The element in question, though continually reinforced by new comers, had practically been eliminated. However, it is a most excellent provision, and combined with a schedule as above laid down would, in my opinion, leave nothing to be desired in the way of punitive regulations.

I have read and reread with great interest Captain Marbury Johnston's excellent article upon "Discipline in the Navy," in the September number of the PROCEEDINGS, but must beg to disagree in toto with his conclusions as to the proper remedy for serious infractions of discipline.

There is no such thing as a universal panacea for wrong doing either in civil life or in the navy, and Captain Johnston exaggerates when he says "Just as soon as the men in the service find out that all liberty breaking and serious infractions of discipline will be punished by immediate discharge as undesirable, just so soon will it be stopped." Had he said "lessened" or "checked," the expression would have been more exact, and with such a statement I doubt if anyone would disagree. The death penalty has not stopped murder however much it may have checked the crime.

Captain Johnston appears, moreover, to have confounded military with moral offences, or at all events has classed them together. For the latter, if serious, I would most decidedly agree that summary discharge is the proper remedy, and one per cent a quarter should cover most of such cases, but for the former I believe that more than one warning may in certain cases be advisable. So much depends upon environment, both before and after enlisting, that, for infractions of purely military discipline, no hard and fast rule for punishment can safely be laid down. In the case cited of Hansen, if it were true that he deliberately overstayed his leave after a plain statement in his hearing of the rule, and the penalty for infraction thereof, then his absence was much more than a

mere absence from work or from duty for a few hours, and he richly deserved the consequences. Indeed one can imagine no other result in a properly conducted military service, and the effect upon the remainder of the crew was no doubt most beneficial. I would not from that case, however, argue that every man overstaying leave for six hours, or even a much longer time, should be summarily discharged even if it were a second offence. In this connection it appears to me that the rule laid down for guidance of summary courts on page 185 "Forms of Procedure for Courts and Boards, 1910," viz., "in case of a second conviction for an offence of a similar nature the punishment should be doubled, and for a third or subsequent conviction, either the maximum or a bad conduct discharge should be adjudged," is safe and sane, and needs no modification. Referring to this rule, it would appear from the cases cited by Captain Johnston from the enlistment records of his ship that someone had been derelict in enforcing the plain directions of the Department. Recently in an attorney's office in Seattle, Washington, I was poring over a musty law book, "Statutes of the State of Washington," one of several volumes, when a bystander, a lawyer and an Englishman, remarked: "The State of Washington has more laws than all the United Kingdom." When one remembers that Washington is a comparatively new state, and only one among forty-eight, to say nothing of the Federal Government itself, the vast volume of American law is at once apparent. The point is this (and Governor Thomas R. Marshall, in an excellent article entitled "The Automatic Citizen," in the September Atlantic Monthly, makes identically the same point) as a people we are too much given to making laws and too little given to executing them, and it is only too true that the navy in this respect but reflects the customs of the people.

While agreeing thoroughly with Captain Johnston in his remarks about the doing away with irons as a punishment, I disagree in toto with his following statement that "the establishment of the deck court was a distinct step backward." I consider it a most decided step in advance, and if thereby captains succumb to the temptation to shirk their duty, the remedy is obvious, viz., to discipline the erring captains. I do not consider, however, that the "temptation" is so great as Captain Johnston would have us believe, but rather that the deck court is a very proper relief of the commanding officer from petty duty, and a step toward more

perfect justice. As for a fine as a punishment creating dissatisfaction, it can affect only those who have offended, and what would Captain Johnston have—a punishment which pleases? The fact that it does not please is only a proof and measure of its efficacy.

I fear that Captain Johnston is again exaggerating slightly when he suggests that were his ideas adopted, all apprehended deserters should be sent to St. Elizabeth's, or some institution for the feeble-minded. Derelicts who are neither insane nor feeble-minded will enlist and desert, and the only remedy that I can see is more care on the part of the recruiting officer. Improvement along this line has been very marked in recent years, but there is room for more. As for fraudulent enlistment being a thing of the past, recent general court martial records do not bear out this statement, nor will they cease entirely until more care is taken at the fountain-head, viz., the recruiting office.

To sum up it appears to me that the present regulations regarding discharge for misconduct, combined with the privilege given commanding officers of discharging as undesirable one per cent of the crew, per quarter, are ample, *if enforced*, to rid the service of its bad characters. Captain Johnston's own statement of the effect produced when he mustered aft the some fifty bad characters on his ship and informed them of his determination to carry out the Department's directions, viz., that only two subsequently committed themselves, is ample proof of the efficiency of the present system—*when carried out*. I quite agree that "all that is needed to make the discipline of the navy what it should be is to start the steam roller and threshing machine, crush out the bad ones, and winnow out the worthless ones." I disagree only in believing that we have had the steam roller and threshing machine already provided. Nothing more is needed than the perfecting of the present system as described in this paper, and as put in practice on the U. S. S. *Pennsylvania*.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE U. S. NAVAL DISCIPLINARY BARRACKS, PORT ROYAL, SOUTH CAROLINA.

By MAJOR CHARLES B. HATCH, U. S. Marine Corps, Comdg.

For some time the Department has believed that the method formerly in vogue, whereby the great majority of offenders against naval discipline were sent to naval prisons and discharged from the service, was a most expensive form of punishment, and one which did little towards the ultimate end in view, that of reforming the offender.

It had been found that a large percentage of prisoners confined in naval prisons were men who had committed purely military offenses and who, on completing their terms of confinement, would be dishonorably discharged from the service, thereby making it impossible for them ever to return thereto. Quite a number of these prisoners were trained men who, in a spirit of thoughtlessness, had committed themselves, and to sever permanently their connection with the service without making some effort to make them realize their mistakes, and at the same time save generally good men for the service, was considered far from meeting the modern idea of dealing with offenders. No attempt had been made up to this time to separate criminals from those confined for purely military offenses, and the whole idea in confinement seemed to be to make the offenders "pay" for their offenses, putting aside, as it were, what should be the chief resultant of all punitive institutions, reformation of character.

To devise means for separating the military and criminal offenders, and to give the former an opportunity to regain their self-respect and remain in the service, if they so desired, the Department convened a board composed of Captains Robert L. Russell and Henry B. Wilson, U. S. Navy, and Major Charles B. Hatch, U. S. Marine Corps, with orders to investigate the conditions of the service, and to recommend such changes in the system then in vogue which, in the opinion of the board, would give the best results. After a careful investigation as to existing conditions in naval prisons the board recommended as follows:

Enlisted men convicted by court-martial should be classed under three heads and dealt with as follows:

(1) *Those Convicted of Crimes not of a Purely Military Nature.*—It is believed that men convicted of criminal offenses should not be confined with those convicted of purely military offenses, only. All cases of filthy nature, theft, and cases where the offenses are not of a purely military character should be sent to state prisons. Arrangements were made with the New Hampshire State Prison at Concord, N. H., in December, 1910, for the confinement therein of naval prisoners, and such arrangements are now in existence with the Connecticut State Prison, Wethersfield, Conn., and the California State Prison, San Quentin, Cal.

(2) *Those Convicted of Military Offenses whose Separation from the Service is Necessary or Desirable.*—Men convicted of desertion from the navy or marine corps must in all cases be sentenced to dishonorable discharge, and their enlistment is expressly prohibited by law. Other cases arise where the offense committed or the record of the offender is such that the retention of the man in the service would be undesirable. All such men should be confined in naval prisons, and dishonorably discharged upon expiration of confinement in accordance with the terms of their sentences. Should the sentence not include dishonorable discharge in such cases, other than desertion, the man should be discharged as undesirable upon expiration of confinement.

Prisoners confined in naval prisons should be allowed only such plain, wholesome rations as may be necessary for their health and general welfare. The selection of guards for naval prisons, their pay, and period of service should be governed by the recommendations made below with reference to guards for "detention quarters."

Persons confined in naval prisons should be worked ten hours per day, if possible, and some means of useful employment should be supplied. The manufacturing of coal bags is suggested as best serving this purpose. However, if this is impracticable, any form of labor which would be beneficial to the government should be allowed.

* * * * * * * *

(3) *Those Convicted of Purely Military Offenses Who may be Developed into Desirable Members of the Service.*—In our opinion, enlisted men convicted of purely military offenses, with the exception of such cases specified in class 2 above, should be confined in detention barracks or camp, termed "detention quarters." Rigid discipline should be maintained at such places of detention, officers being detailed for duty thereat who are known to be good disciplinarians, and, also, who possess a good knowledge of human nature. Enlisted men who may be thus confined should wear the service uniform and should not be known as "prisoners" as the term is usually applied. They should be put through a carefully selected course in service drills and instructions so that at the end of their detention they may, if recommended as desirable, be returned to the service as proficient as possible. During the time under detention their pay and leave should be stopped as at present, the men being allowed only their uniforms and such other articles, including tobacco, as may, in the opinion of the officer in command, be deemed necessary for their health and comfort.

As respects rations, men in detention should be given the regular rations, except desserts, special holiday meals, and extras. . . .

Upon being released from confinement in detention quarters, men not discharged should be placed on probation at the place of detention, allowed liberty, and given the same amount of work and responsibility as would be given them if they were placed on probation on board ship or at barracks. No man, with the possible exception of a very few special cases, should be placed on probation in the general service; that is, on board ship, at naval stations, or in barracks.

Officers on seagoing ships or in regular barracks have not the time to devote the necessary amount of attention to the cases of men serving under their command on probation.

The place selected for "detention quarters" should not be a makeshift. It should have good airy barracks, plenty of ground for drill and exercises, and should be located in a temperate climate so that outdoor drills could be carried on the year round.

The men to be used for guards should be carefully selected men of known excellent character, they should receive extra pay and be kept on this duty during good behavior. Owing to emergencies frequently arising which now require the detail of men on prison duty to other stations, it is recommended that men so detailed as guards be not transferred unless the call for their services elsewhere is extremely urgent. It is believed that in thus selecting men as guards fewer will be required and better discipline will be maintained.

We believe that in most respects the best location for the proposed "detention quarters" would be at the naval station, Guantanamo, Cuba. However, owing to the expense and other obstacles—especially the necessary frequent transfer of men to and from Guantanamo—it is recommended that for the present the proposed "detention quarters" be located at some place in the southern part of the United States where outdoor drills can be carried on the year round.

It is strongly recommended that the "detention quarters" feature be tried out for a period of at least one year, by the transfer of not less than three hundred men to such point as may be designated for the "detention quarters" where this idea could be thoroughly developed and given an opportunity to demonstrate its value to the service.

As will be understood from the foregoing, the objects of the proposed system are, first, to prevent enlisted men convicted of offenses solely against naval discipline from being subjected to the stigma attaching to imprisonment, and, second, saving to the service of a large number of such men who give promise of becoming, under proper discipline, desirable members thereof. With this in view, it is recommended that there be adopted a form of punishment to be termed "detention" and that in cases that may be deemed worthy of such clemency the Department mitigate sentences of imprisonment to "detention."

* * * * * * * *

In accordance with this report the Department directed that a detention barracks, to be known as the U. S. Naval Disciplinary

Barracks, be established at Port Royal, South Carolina, placing in command the writer of this article, together with six marine officers, two medical officers and one pay officer, with the necessary enlisted force to carry out the work.

During the fiscal year 1912 some four hundred fifty enlisted men have been sent to Port Royal instead of the naval prison for confinement, the terms of their sentences having been mitigated by the Department to detention. These men, instead of being placed in prison garb, retain their service uniforms, are drilled and exercised as though serving at a regular station, and are at all times kept occupied in some form of healthy work or exercise.

On completing two-thirds of their sentence in the detention barracks, from which no liberty is granted, and where strict discipline is maintained, those detentioners whose conduct has been excellent are placed on probation for the remaining third of their sentence. During this period of probation they receive service pay, are granted liberty, and are treated in every respect like men on duty in the service at large. During this period the officers at the Disciplinary Barracks are able to judge just how these men will act in service, and whether or not their retention therein is desirable.

Those men who show during their period of detention that they are undesirable are discharged from the service in accordance with the terms of their sentences, or as undesirable in cases where their sentences do not include discharge, and men found desirable at the termination of probationary period are unconditionally restored to duty and sent to some receiving ship for general detail in the service.

If it happens that a detentioner's enlistment has expired in detention, or would expire during the probationary period, he is discharged from the service at the expiration of his period of detention, and if his conduct warrants such action, he is recommended for re-enlistment. In a number of such cases the man concerned has applied for re-enlistment the day after his discharge, and has been re-enlisted at Port Royal, the commanding officer there having been designated as a recruiting officer by the Department for such purpose. During the fiscal year 1912 one hundred men who, under the old form of confinement in naval prisons, would have been lost to the service, have been returned to duty. Twenty-one others who, on account of expiration of enlistment, could not be restored to duty, were recommended for re-enlistment.

This form of punishment permits the enlisted man to retain

his self respect, there is no stigma of prison garb or life attached, and he goes into the service a better man morally and physically, and the service gains in receiving a lot of well-drilled men who in the past were lost by discharge.

As much responsibility as may be compatible with discipline is given detentioners. Every effort is made to encourage them to assume that amount of responsibility which is held by any well-trained and disciplined body of men. The detentioners at Port Royal are divided into companies, each company having its acting petty officers detailed from its own strength, and officers and non-commissioned officers are detailed to drill them.

Six mornings of the week are devoted to four drill periods each, during which the detentioners are exercised in all the service drills, including infantry and field artillery. The afternoons are devoted to general work around the post, and to athletic exercises. Everything possible is done to keep the men busy and interested in their work. Those detentioners who have trades such as carpenters, painters, plumbers, blacksmiths, machinists, etc., are in addition to their drills worked at their trades making repairs to the buildings, boats, and machinery in order that they may be as efficient as possible on returning to the service. Helpers are detailed with these men for the purpose of giving the assistants an opportunity to learn a trade for themselves.

Port Royal had been abandoned as a naval station for a number of years and the buildings there were, when the disciplinary barracks was established, in poor repair. A few days before the post was established the place was visited by a severe storm which uprooted all the large trees, some ninety in number, broke nearly one thousand window glasses, unroofed five of the large buildings and left the place generally in a deplorable condition. All these repairs have been made by the labor supplied by the detention and probation barracks, making it unnecessary to employ outside labor and thus saving a considerable sum to the Department. In fact, the entire post, including the water pumping station, heating and lighting systems, is run by enlisted men.

During the fiscal year 1913 it is the intention of the officers at Port Royal to start classes in special work, where detentioners, in addition to their regular service drills, will be taught useful trades which will be of benefit to themselves as well as to the service on their return to duty. These classes will be in seamanship, with boat drills under oars and sails; signals, both day and night; sailmakers, learning to perform the work of a sailmaker's

mate on board ship, and a class of radio operators. For the last named a small radio station will have to be established at Port Royal, and an experienced operator will be sent there as an instructor.

In addition to these special classes the character of the drills are to be extended. Practice marches will be frequently taken, the men will be instructed in field fortification, landing operations, advance and rear guard formations and outpost duty, target practice with the service rifle, and in fact every service drill which will make them more efficient.

By a rearrangement of the duties of the officers at Port Royal, and on the reporting of an additional officer, it will be possible to detail three officers to duty in the detention barracks, where from one hundred seventy-five to two hundred fifty men have been quartered.

With officers interested in this kind of work, men who will devote their entire time to working with the detentioners, helping them individually, and keeping them interested in their advancement, it is considered that the detention idea is a success, and that the service as well as the detentioner is to derive great benefit from it.

The men received at the Port Royal Disciplinary Barracks for confinement are not criminals, but men who have committed some offense against naval discipline. Generally speaking they are men of good character who, through lack of forethought, or during a moment of uncontrolled passion, have allowed themselves to commit offenses of which in saner moods they are repentant. Human nature is frail but is generally amenable to correction and discipline if properly administered, and while all men at some time make mistakes, it does not necessarily follow that all men are bad.

It has been found that some good may be found in nearly every detentioner, and that it only requires the well directed energy of an officer to bring this good to the front. Individual treatment and help on the part of the officer often saves a man from being lost to the service, and it is believed that in this individual work lies the success of the detention idea. Certainly there is no better work in the service; none which will show better results, and the more work and effort on the part of the officers, the more men saved from themselves for the service.

At a time when the whole country is interested in prison reform work, the detention idea in the service brings the navy prominently to the front in its efforts to assist offenders against its discipline.

COMMANDANT AND SUBORDINATE STAFF, ALDERSHOT DETENTION BARRACKS.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

REFORMATORY TREATMENT OF SOLDIERS AND SAILORS UNDER SENTENCE OF DETENTION.

By LIEUTENANT-COLONEL G. HAINES, British Imperial Service, and Commandant Detention Barracks, Aldershot, England.

I am very willing to write all I know on this subject, but it is impossible to lay down hard and fast rules where every case differs in various degrees from the next.

Our latest revised rules have been placed at your disposal. They are as complete as such things can be. It is in the method of obeying those rules that the real difficulties lie, although they have been compiled with extreme care to meet those difficulties.

Even a drill book is a weary thing without the drill instructor, and *he* must have the knack of imparting its contents, so that his hearers may understand and remember what they are told.

I fear this fact was made only too apparent in my article entitled, "Punishment as Applied to Soldiers and Sailors," which was so kindly and generously received by your magazine, and I am encouraged, by the reception accorded to my maiden effort, to write anything I can to assist in bringing about reforms which are evidently needed, and to unravel the maze of tangles which beset our path in the first few years of evolution in England.

I must try and imagine that, in addition to being very much with you in the spirit, I am actually "alongside" in the flesh; and that after having greeted the American officers who have visited my establishment, and taken a bird's eye view of our system, I say "Well, gentlemen, its time we make a start"—and I take charge right away.

What have we got that we can do without?

What can we put the pen through as being fundamentally antagonistic to "Reform"?

There are several such, but they all come under one head, viz. *Stigma.*

COMMANDANT AND SUBORDINATE STAFF, ALDERSHOT DETENTION BARRACKS.

1. Penal treatment,
2. Prison clothing,
3. Prison terms, the word
4. *Prison*, and
5. All degrading and non-productive employment, and life, or rather "existence," behind locked doors.

I never could see why any sailor or soldier, who has broken the naval or military laws of discipline, should be branded for all time. I am glad to see that the reformation of convicts is not considered hopeless nowadays; and, provided the crime does not come under the head of "cruel and unnatural," and it is not a monstrous or hideously cowardly kind, I think the brand of Cain can be dispensed with.

But there are other good and sufficient reasons why a sailor or a soldier should not be liable to carry the mark of the beast. To put it simply, *his family don't like it.*

A family (A) which has produced soldiers and sailors, and which merits its country's thanks, may produce *one* "bad hat." Another family (B) which has not as yet produced any recruits, but fully intends to put their lads into one or other of the services, sees what has happened to (A), and all its boys go into something else.

In reforming A's "bad hat," and keeping him free from stigma, you return him to his family in his right mind, earn the family's gratitude, and you need not fear obstruction in that quarter. Moreover, the stigma of a prison reacts upon the man when he becomes a civilian. It lasts a life time. This is obviously wrong *if* "it is [really] never too late to mend."

Let us therefore rule out stigma—and find something to replace it.

It is a sticky thing and must be made to adhere *only* to the man who richly deserves it.

In the first place the automatic process is the most potent aid.

Gratitude for the removal of disgrace is going to help you more than you would at first credit. The men themselves will do more than half, by showing how they appreciate a real boon.

The technical difficulty lies in the business of making the treatment, divested as it is of degradation, deterrent in the highest possible degree. This is a matter of training.

The officers entrusted with this work (they must be commis-

sioned officers) must necessarily be highly trained men. They must carefully train the staff under them. They must make very few, if any, mistakes, and they must know thoroughly well all matters connected with the service to which they and the men under detention belong.

Well-meaning men are so often hustled into trouble by the ignorance and incapability of junior non-commissioned officers.

Their chief faults are:

Inability to wield authority,

Eyewash,

Impatience, and swelled head.

Such men cannot command respect, and they *make crime.*

When a man comes to the Aldershot Detention Barracks he finds himself under a staff of experts, and he realizes how easy it is to behave well under such circumstances. He knows more about his profession on leaving than the non-commissioned officers described above; and he knows how to avoid running foul of such people.

Some time ago I had a very interesting example of this.

A man arrived with a name for being a desperate character. I was warned about him by his commanding officer. He had evidently been badly adrift. He was slovenly, idle, and inclined to be insubordinate. After a time I began to notice something about him which interested me. His appearance on parade was improving, his movements were brisker, and his surly look had disappeared. Later he became one of the smartest fellows in the place. His "turn out" was splendid. His shooting was beautiful. He could almost write his name on the target. He looked you squarely in the eye, and his room was a marvel of neatness and cleanliness. Shortly before his release I had a long chat with him.

At last I asked him, "How is it that you can soldier in a place like this, and not with your corps"? He ripped out instantly with the reply, "Well, sir, there ain't no —— lance corporals here!"

He rejoined his unit, *I* have not seen him since, so I suppose he is doing well.

"Prison" means "Punishment."

"Detention" means "Reformation."

"Prison" is a sad and sordid place for all concerned with it. It is a very necessary, nay, indispensable institution; but not for men serving for the honor and safety of their fatherland on land and sea.

"Detention" is elevating, progressive, instructive, healthy and reformatory in every way—but,

Is detention deterrent? A fair question. The answer is emphatically *Yes.*

Statistics amply prove this, and you have them in your possession.

The numbers of committals for years past have steadily diminished, until the absence of crime in the army has become a matter of particular interest in this country.

The reason is that *the men* have got to know about detention. Those who know it by experience have told their comrades who do not, and the strenuous routine of the "busy day" is looked upon as a thing to avoid. Then again, *the officers* have got to know the system.

Here in Aldershot, and in all stations where there are detention barracks, every young officer has to attend for instruction, and dozens of the senior ones come voluntarily.

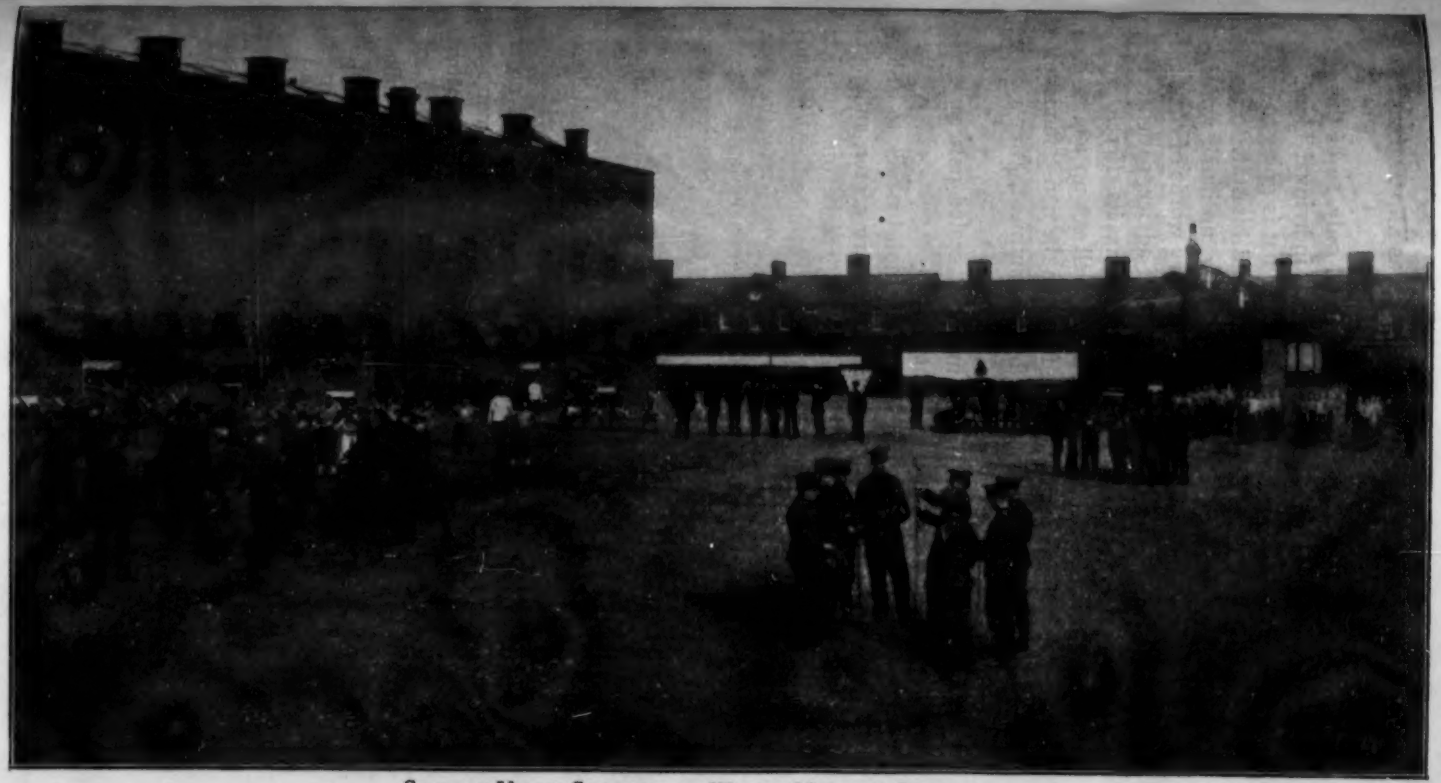
The other day a company officer said to me, when leaving after lecture, "Well, *now* I don't mind so much if my fellows miss *company training* by being sent here, I find they lose nothing."

Officers commanding units come as visitors, and they recognize the utility of the place and send men in to have their weaknesses eradicated and their ignorance removed by the careful individual attention which they cannot receive in their corps.

A notorious burglar found himself landed here some time ago. He had enlisted, of course, under an "alias," in order to try and shake off his old associates, and go straight. There were several convictions against him, and he had done time in most of our large convict prisons.

I found him a very interesting man to talk to, and I asked him his opinion of our system. He was good enough to approve of the principle, "*but,*" said he, "there is a great deal too much work here, sir; if I had got a long sentence (he was doing 28 days), I shouldn't stay with you!" I suppose he was as clever at getting out of places as he was at "effecting an entrance." I look upon this gentleman's testimony as a high compliment to the deterrent effect of detention.

In order to make the routine of a detention barrack real and genuine, and the treatment reformatory, it should have a capacity limited to hold only 200 men, or thereabouts.



SOLDIERS UNDER SENTENCE AT WORK. MILITARY INSTRUCTION.

There are only 24 hours in the day, and only 10 of these can be spent in reformatory work of the right "individual" kind.

Men must be informed on admission of what is going to happen to them, and it is up to the commandant and his staff to see that it *does* happen to them. No angry shouting, no harsh words, no pushing or shoving, none but naval or military words of command; or by bugle, whistle, etc., but plenty of quiet advice, patience, help, sympathy. The mere "dignity" of the thing has its effect.

The staff should be hefty and strong, well set up and of good appearance. This generally will be found in the non-commissioned officer who is finally confirmed in his appointment, after a course of probation.

He is in every sense a picked man, a "sealed pattern." The sight of him is good for the evil-doer.

For a start I would recommend a detention barrack to be built or reappropriated in some big naval or military center, and placed under an officer whose tact and patience are beyond question; whose heart is in the matter of reform, and whose head is full of the information so gladly supplied by those who know the game.

The first step might be looked upon as experimental. "Provisional" regulations must be drafted, carefully considered and passed.

Sentences for offences against discipline *only* should be inflicted ranging from 28 days to 6 months.

Great attention must be paid to personal cleanliness, and "good order" in the "rooms." The food should be good, well served, and sufficient. These things act automatically and need no further explanation. They are the foundation on which a man's self-respect is reconstructed, and which, with the general treatment I have already described, produce a sane mind in a healthy body.

I have before me a letter dated 11th May, 1912, from an admiral who sat in committee on our military detention system at the commencement of 1909. He says: "Our detention system is, I consider, a great success."

I have also a report rendered to our Admiralty in October, 1907, by a naval officer, whose wide experience as governor of a British naval prison, and whose first impressions of a British *military* detention barrack, are of the greatest value.

This officer's grasp of the situation, and the splendid honesty with which he records, in simple words, his conversion, must carry conviction to the minds of all who read his remarks.

I have permission to quote him:

* * * * * * * * * *

I am unable to form any independent opinion as to the suitability of the military system as a *deterrent from offences*, but the military reports seem amply conclusive in its favor.

But, as a *means of punishment for disciplinary offences*, I consider it far superior to the existing naval system, though I was strongly predisposed against it when I started from here. Any remarks on the two systems inevitably fall into a statement of strong and absolutely opposed contrasts; no comparisons are possible.

MINIATURE SHOOTING RANGE SHOWING FALLING FIGURES.

The military system aims at "removing the stigma of imprisonment" from men in the army, and is carried out in all its details to the full logical extreme.

* * * * * * * * * *

Prison terms are avoided. The "prison" is a "detention barrack," the "governor" is the "commandant," "warders" are "sergeants" or "the staff," "prisoners" are spoken of as "men," "cells" are "rooms," "imprisonment" is "detention," and the men are known and addressed by name, not by their numbers; they also retain their connection with their corps or regiments, and are throughout under the Army Discipline Act. Thus, the term "imprisonment," associated in most minds with criminals, of even the worst kind, is not associated with respectable men, who are under punishment for mere disciplinary offences, not disgraceful crimes.

* * * * * * * * * *

The men are received in their regular uniforms, and in heavy marching order with their arms, which are in use constantly during their "detention." This avoids the public scandal of men in H. M. service being seen in the streets and trains handcuffed, and in what is evidently a prison dress, and sometimes arriving here at the same time as batches of convicts chained together, which is degrading to the men, and a slur on the service. This also avoids the expense of prison clothing, as none such is worn.

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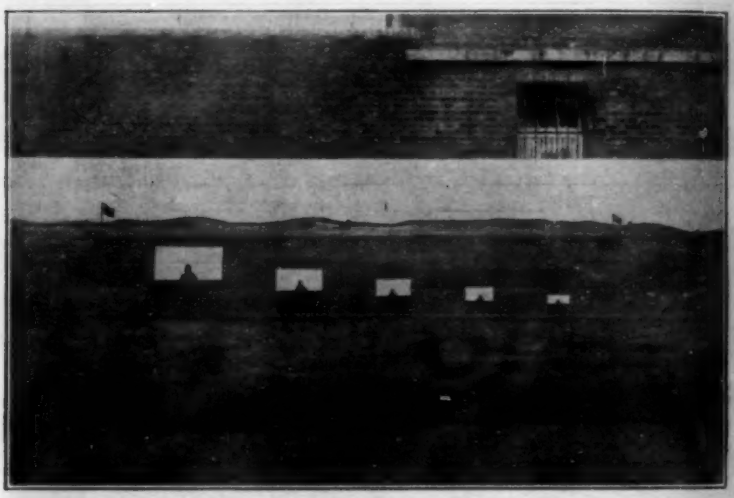
No useless labor is done, all the physical fatigue, which shot drill aims at as a part of the punishment, is inflicted much more efficiently by squad



FIRST-CLASS TARGET IN MINIATURE.

Its appearance on the real range from a measured 35 yards demonstrated at 200 to 600 yards, inclusive, "all up."

and company drill, the men being kept on the move as long as it lasts; and by Swedish exercises in which they are thoroughly taxed in every kind of muscular exertion.

I saw men in a state of breathlessness and sweat which is never dreamed of in a naval prison, and those who had been under the system for a short time were "hard as nails," and able to double round the exercise ground for two miles at a stretch.

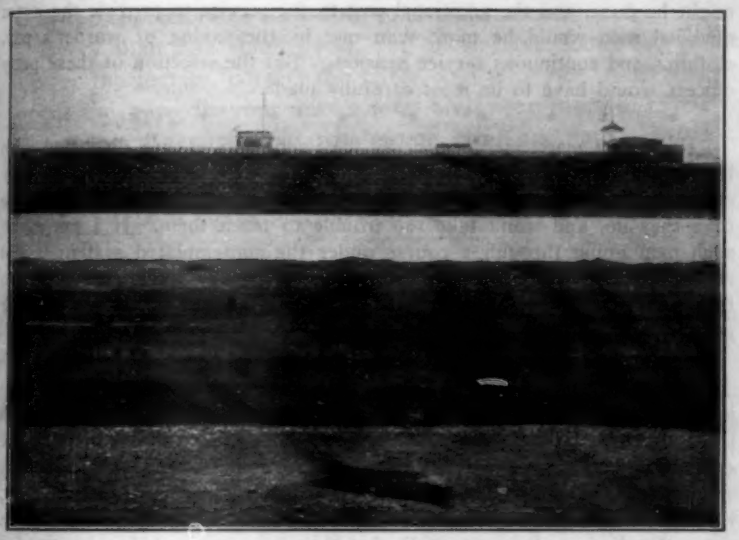
The men are gradually brought up to this under the observation of the medical officer.

The industrial employment is in "association" except in the evenings in their "rooms" after supper. This is a great advantage, for the men are thus kept under observation all the time they are at work, and cannot

"slack" off, so that the different abilities of men to do such work is fairly provided for, in a much more equitable way than by allotting fixed tasks, which, while fully occupying an old hand, shall not be unjustly severe on the beginner.

* * * * * * * * * *

The loss of an hour daily for exercise, as in a naval prison, is avoided. Instead of a mere walk round a yard they have a vigorous "rouse about," and instructive set of drills, which must be more beneficial to the men, and, therefore, to their efficiency for duty on discharge, than mere walking,



BATTLE-PRACTICE TARGET FOR VISUAL TRAINING, FIRE CONTROL AND DISCIPLINE.

Range 25 yards, figures to scale representing 150 to 1500 yards. The figures move at will and are worked by signal from behind.

and sedentary work in cells, out of which many men only come for 1½ hours daily for weeks.

* * * * * * * * * *

I was informed by my chief warder, some little time ago, when discussing with him the employment of some men just received from Malta Military Prison, that many had told him that they preferred the "quiet, sit in your cell" life of a naval prison, to the hustle of Corradino.

* * * * * * * * * *

In addition to the infantry drills the men went through fairly stiff obstacle races, and the emulation evinced ensured a fatigue which very few men would willingly incur, and fewer still voluntarily often repeat.

Semaphore and Morse were being taught, and the circumstances compelled the men to learn them which very few men of that class would voluntarily take the trouble to do. They were thus made more efficient for their service, and, considering that naval men are, as a rule, superior to army recruits, this appeal to their intelligence seems to me to be most desirable.

Musketry and Morris tube practice are taught with good results. These and the Dotter would be of great advantage, as privileged instruction, to our well-behaved men.

The instructors are smart, non-commissioned officers. If gunnery instructors were sent to our prisons for their last three or four years, a great deal might be done, and the additional cost to the service to provide the extra qualified men would be more than met by the saving of warder's pay, clothing, and continuous service pensions. But the selection of these petty officers would have to be most carefully made.

* * * * * * * * * *

I think that many men, especially the younger ones, are disgusted with the service, and get into trouble through being harrassed by their petty officers, who are impatient of their ignorance, expect them to know more than they do, and won't take the trouble to teach them. If I am right, such men going through a course under the contemplated system would return to their ships with confidence in themselves, and ability to do their work better, and so would no longer be a source of irritation to their petty officers.

* * * * * * * * * *

I don't think it need be feared that, with the increase of improving accommodation the discipline of the service would suffer through the punishment not being penal enough. After all the men are not criminals, and sometimes were not really the ones most in fault (though this could not be pleaded except as I am now submitting it), they are, as a lot, good-hearted, straight men; and I have found with even the worst (one or two excepted) that they have responded quite respectfully to any individual appeal or show of personal interest. Quite recently when a man was brought before me for the 6th or 7th time in a short interval, for persistent laziness, I said to him, "I have tried every punishment on the list, now I'll try one which is not mentioned, and see how you take it, I let you off and give you nothing this time." He said most respectfully, "Then, sir, you'll not see me up again." And I did not. He gave me no more trouble during his remaining month or six weeks.*

* * * * * * * * * *

It is worth mentioning that in their letters home, which I have to read, the men are at some pains to impress upon their friends that this is not a civil prison, and they point out the difference between crimes and offences. Let us get rid of all criminals.

To utilize the reputation which the army system has begun to get (and to strengthen it by adopting it), that men in the service places of confinement are not on the same footing as common criminals, I would like

* This very seldom fails.—G. H.

to see the army nomenclature adopted, and as far as practicable the procedure also.

The military system is found to give excellent results with men whose average period of confinement is less than 30 days. I should expect better results with us, for I find that during the last 6 years the average period of confinement has been (approximately) more than 60 days in this prison.

The question of material.

To sum up, the value of saving good material has, I trust, been made plain. The raw article is, on the whole, splendid. It improves or deteriorates according to circumstances.

Every man has some good, and most have some bad points. Foster the former, correct the latter, and your net result *must* be good, the gaps in your ranks few, and your morale, efficiency, "form," and general tone, wholesome, clean and satisfactory.

STATEMENT SHOWING THE NUMBER OF SENTENCES SERVED DURING THE YEAR IN DETENTION BARRACKS BY INDIVIDUAL SOLDIERS.

	Number of times.				Total.
	Once.	Twice.	Three.	Four and over.	
Aldershot	1,728	183	43	14	1,968
Colchester	360	45	12	4	421
Devonport	284	40	7	4	335
Gosport	634	54	21	4	713
York	410	37	6	2	455
Cork	330	40	8	..	383
Dublin	655	46	11	2	714
Stirling	145	14	1	..	160
Bermuda	23	5	..	..	28
Cairo	149	13	2	3	167
Gibraltar	227	15	5	4	251
Hong Kong	79	12	5	2	98
Jamaica	44	6	1	..	51
Kandy	12	2	1	..	15
Malta	287	75	20	42	424
Mauritius	40	...	..	..	40
Pretoria	276	56	16	8	356
Seirra Leone	47	3	3	1	54
Singapore	29	4	..	..	33
Wynberg	61	10	3	1	75
Chelsea	214	24	3	1	242
Pembroke Dock	59	9	2	..	70
Shorncliffe	284	25	3	1	313
Woolwich	152	14	6	..	172
Jersey	22	2	..	..	24
Khartoum	21	...	..	..	21
Total	6,572	734	179	98	7,583

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE U. S. NAVAL ACADEMY.

AN UNDERGRADUATE'S POINT OF VIEW.

By MIDSHIPMAN ERNEST G. SMALL, U. S. N. A., Class of 1912.

It was with some degree of trepidation that I approached the subject of the Naval Academy from an undergraduate's point of view. Having been steeped in a naval atmosphere for four years, I have absorbed a respect for authority which has made me hesitate to add my opinions on this subject, to those advanced by officers much my senior. There was also the fear, closely akin to the Chinese fear of "losing face," that in a few months after graduation, I should find my judgments reversed by virtue of a sounder knowledge of what is required of an officer. However, I have persisted in my attempt, and I present my impressions of the Academy system, its tendencies, and also some suggestions that have occurred to me. The whole paper will be, of necessity, of a rambling nature, and will be only what it pretends to be, an undergraduate's views.

In considering the scholastic side of the Naval Academy, the system of instruction combines the Oxford system of education and the American university system. Briefly, the Oxford idea is to leave the undergraduate largely to his own resources for three years, and then to set an examination for him, by which he stands or falls. This plan of education exercises the judgment and discernment of the student to a high degree, for it is obvious by the very nature of the case, that the examination must concern itself with practical knowledge, broad principles, and not with a mass of trivial detail. The American university system makes each half year complete in itself. The American student finishes his freshman Latin, his analytic geometry, or what not; forgets it; and seeks for new worlds to conquer. I repeat the Naval Academy system combines these two systems. The midshipman's half

year is complete in itself, but he must take a semi-annual and annual examination in every subject; and these examinations, unlike an Oxford examination, in most cases, do not concern themselves with broad principles, but often do ask for very minute knowledge. The net result is that all but exceptional midshipmen suffer from a mass of undigested knowledge. Under the scheme of exemptions formerly in operation whereby a midshipman having a mark of a 3.00 or over (out of a possible 4.00) for the term, was exempt from the examination, the majority solved the problem in the most economical way. Since it was easier to get a 3.00 by making each month complete in itself, they made the month the objective, and avoided the examination with its attendant work and worry. At the present time the midshipmen are floundering, hoping to pull through somehow. Personally, I believe that the Oxford idea is good, and that an examination is a valuable index to "present character and true worth," to borrow a familiar phrase; for it is not what we have learned an hour ago that counts so much as our ability to produce our knowledge six months hence. An examination is simply a concrete application of the principle of "by their fruits ye shall know them," a principle as equally applicable to things mundane, as to things religious. To make the examination effective, to conserve its true spirit, care must be exercised by those setting it to see that it is fair, broad in its scope, and not a gigantic feat of memory.

This congestion, this cramming process, is largely the result of the attempt to meet the increasing requirements of the naval profession in the same time as was required forty or fifty years ago, when steam was in its infancy, and fire control unborn. The results are bad. Specially prepared text books in "tabloid" form are issued to midshipmen, and they are required to accept fact after fact, because "the book says so." The valuable training given by modern education in weighing evidence is missed altogether, and the student develops a slavish adulation for the book.

There is one benefit. Early in his course, a midshipman learns the value of "bluff." The first time he is called upon to recite on a subject he knows nothing about, he asks to be excused. Presto! He gets a maximum of a 2.00 for his second subject. The next time he gets a subject he knows nothing about, he presents some product of his commonsense that often times brings him a 2.50.

I have known a section after a recitation to remonstrate in no uncertain manner with a member who had refused a subject. This training is valuable in that it instills a little of the "Message to Garcia" spirit, so necessary in a military organization.

As an illustration of this training and its effect, it is amusing to note the discussions that often arise among midshipmen as to the value of a Naval Academy education for engineering professions. The majority seem to think that lucrative employment is bound to fall to the lot of any graduate on the mere mention of the name of his alma mater. Little do they consider the exacting requirements of modern engineering, the long apprenticeship, and the high degree of specialization required. All this goes for nothing. The spirit of do what you are told, for it can be done, is so inbred, that it completely overshadows the difficulties. Judging by the records of Academy graduates in civil life, the contention of the undergraduate is probably true. The graduate would succeed, because he simply would not fail.

Crowding is not only felt at the Naval Academy, but elsewhere. The alternate work a week, and study a week plan, covering a course of six years in the engineering school of the University of Cincinnati, and the requirement of a bachelor's degree for admission into the engineering schools of Columbia University, are but signs of the times. The increase of technical knowledge and the glut on the market of professional labor are perhaps the determining factors. It has been proposed to meet this requirement of more preparation, at the Naval Academy, by a five years' course of instruction. The objection to this plan is, that it postpones for a year the advent to sea, the only place, so many authorities tell us, where a man-of-warsman can really learn his profession. This objection might be overruled and the five years course established, if there were no other remedies at hand. But are there not other remedies?

It is a fact that the requirements for entrance to the Naval Academy, when compared with those of other scientific schools, are low. Most scientific schools of the caliber of the Massachusetts Institute of Technology, Stevens, and the University of Wisconsin, require in addition to the Naval Academy requirements, two foreign languages, physics, chemistry, solid geometry, plane trigonometry, a more extended knowledge of algebra, and a working acquaintance with mechanical drawing. Why should not

the Naval Academy demand as much? If the Academy is designed to furnish an education for youths from the entire country, from regions where educational advantages must of necessity be few, much in the same spirit as our public schools seem to attempt to train every child as a potential president, of course the requirements can not be raised; but if the fact is recognized that with the increased density of population and its consequent keener competition in the professions, a larger field is open, there is no reason in my mind why advantage should not be taken of this condition to raise the requirements. Paradoxical as it may seem, I do not belive the number of candidates for appointment would be cut down, for men like to strive in proportion to the hardness of the struggle. It may be urged against this scheme that the age of admission to other scientific schools is higher than that required for the Academy. I can speak from but a limited knowledge on this point. The Academy age for admission is from sixteen years to twenty years. The authorities of the Massachusetts Institute of Technology, an admittedly superior institution of its kind, recommend that freshmen be at least seventeen years of age. Briefly, raising the entrance requirements commends itself to me as an intensive cultivation of resources already at hand.

The second remedy I would propose is to put off the fifth year until the graduate has had sea experience. Let the four years be as broad in its course of study as possible. Let him go to sea for two or three years. There will he find himself as truly as did that ship of Kipling's. At the end of this period, having tested his capabilities and found his specialty, let him take his courses in steam, electricity, ordnance, international law, or in whatever field his ability lies. Does not the present system tend to turn out specialists in all branches, regardless of the limited capacity of the human machine? Is it not true that every new advance in the naval profession has meant an increase in the Academic working pressure to the end that the graduate be familiar with every branch of a profession which in a way is more than an epitome of all others?

In regard to the teaching by practical work—everybody recognizes that the laboratory method of teaching is essentially a correct method, and that it has come to stay. I shall not attempt an analysis of this feature at the Academy, but be content with a few random impressions. It seems to me that midshipmen are shown

how a thing is done, but are given little opportunity actually to do it. To illustrate, on a practice cruise our midshipman watches a fireman clean fires, and at the end of the week writes in his notebook a very glib account of the manner of cleaning fires. But he misses something in not actually cleaning the fires himself. The important factors of heat, blistered hands, the knack of turning the tools, he misses altogether in his book account; and it cannot be said of him with certainty that two years later he will be able to grab a shovel from an inefficient fireman, and show him how fires should be spread. I suggest putting him on the fires, seeing that he actually oils during his watch below, putting him in the gunner's gang, letting him crawl through the roller path, to the end that he gain a practical familiarity with the duties of keeping a turret in shape, and then as a check, let him write a *short,* concise account of the duties done. The secret of efficiency in practical work is to give him more responsibility, and to see that he measures up to the standard that responsibility demands.

The matter of discipline has, I suppose, brought out more discussion than any other feature of military organization. Everyone seems to have his own views on the subject. I am no exception. The system in vogue at present at the Naval Academy is the time honored one, a multitude of regulations to be kept, with punishment sharp and certain for breaking them. This arrangement certainly produces a valuable training. The habit of seeing that one's locker door is closed whenever one is absent from the room (to mention just one of the many requirements that must be lived up to) is excellent in that it fosters a habit of care. There are features, however, that might be eliminated, I think, with profit.

One of these features is the custom of placing a midshipman on the report when the proof of his wrong-doing is insufficient. Under the splendid code of honor that exists, the midshipman has but to make a written statement to the effect that he did not do the act charged, and the report is removed. Surely, it will be urged, there can be no objection to such a truly Arcadian arrangement. But, the fact is, midshipmen are not Arcadians. They are Anglo-Saxons with all the Saxon dislike for shouldering the burden of proof of their innocence. I have known numbers of cases in which midshipmen have taken their demerits for offenses of which they were not guilty, because they would not make a

written statement, an act which they considered equivalent to proving their innocence. Foolish? Perhaps.

Surely it is reasonable to ask that this condition be remedied, if for no other reason than that the sentiment it engenders is subversive of discipline. There is another reason calling for a change. The many opportunities given to persons in and out of the naval service to report midshipmen creates in the minds of the latter, if not a fear, an unwholesome respect for whoever ranks them. It is not inconceivable that in the after lives of some of them, there will come a time when they must perform a duty that will be very distasteful in its working out to some one who ranks them. The present scheme of things will hardly produce strength to meet such a crisis.

The remedy to me is simple. Change the system of reports to that system which obtains at sea. Let trivial reports go by the board, and above all, let there be a solid basis in fact for every report. By this means, there will not be a new order of things to be learned on going to sea. I have in mind a few words of advice in the "Hints to the Graduating Class" which illustrates my point exactly: "No captain is pleased to find a large number of men at 'the mast' each morning, and the officer who makes needless reports will hear from him. It is a sign of inexperience."

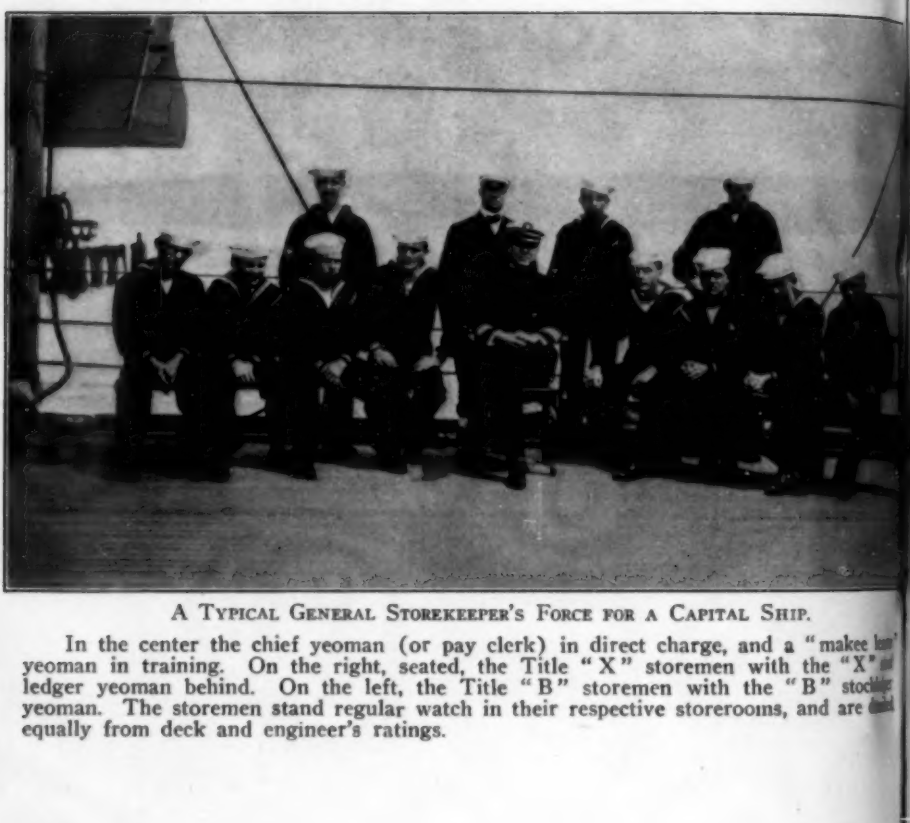
The transition at present from the strict and minute control of the Academy to the responsibility of an officer is a very sudden one, so sudden that it often overthrows the balance of the graduate. The effect of the change could be lessened by making the transition more gradual. Give the upper classmen more responsibility and more privileges. The privilege of leaving the city of Annapolis for a few hours, say Saturday afternoon and evening would be highly prized, would tend to greater content, and would result in higher efficiency. It may be urged that the privilege would be abused; but in the main I doubt it. Midshipmen are proud of their service and their uniform, and if the facts were plainly put to them, they would see that they were a credit to the service they represented while away. I can think of so many occasions in my four years when a few hours change of scene would have meant a great deal. It would have meant so much to me that I would have striven with might and main to earn the privilege if I had had the opportunity. This is a suggestion of what might

be done. Responsibility and privilege are powerful agencies in character building.

The athletics of the Academy are splendid, and one can take just pride in them. The evils of paid admissions are avoided, professionalism is unknown, and everybody takes part in athletics to a greater or less degree. The Brigade, while it watches the development of the first team with keen interest, and supports it in its contests as one man, does not leave sport to the first team alone. I doubt whether there is an institution in this country where the number of scrub and class teams is so proportionally great. Of the harmfulness of particular branches of sport, I have nothing to say. That is a matter for medical experts to decide. What I do wish to bring out are these: Competition with outside teams increases the interest in athletics for the rank and file. Athletic sport brings out qualities essential to military leadership, for the records of the past few years show man after man of whom it can be truly said, that athletics brought out all his qualities of leadership.

To sum up, there is a fruitful field awaiting development in the matter of raising the entrance requirements; the need is for a broader course with specialization later; practical work should be more practical; a more extended application of responsibility and privilege would bridge the chasm between undergraduate and graduate; and the existing evils of the present system of reporting should be changed.

In conclusion, I cannot help speaking of the sense of power and poise one feels one has attained as the result of one's training at the Naval Academy. Here I am bordering on things that one does not speak about. There are priceless possessions that one cherishes, but never mentions. After all, the four years have been good, not always pleasant, but well worth the struggle.



A Typical General Storekeeper's Force for a Capital Ship.

In the center the chief yeoman (or pay clerk) in direct charge, and a "makee learn" yeoman in training. On the right, seated, the Title "X" storemen with the "X" stock ledger yeoman behind. On the left, the Title "B" storemen with the "B" stock ledger yeoman. The storemen stand regular watch in their respective storerooms, and are drawn equally from deck and engineer's ratings.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE SHIP'S GENERAL STOREKEEPER.

By PAYMASTER G. P. DYER, U. S. Navy.

Under this caption I propose to set down as simply as I can the details of the work of the general storekeeper of a cruising ship, with the ideas and methods which, in my opinion, should control such work. Many of these ideas and methods have never been reduced to writing, being heretofore embodied in tradition only.

My inspiration has been the general interest which a résumé of the modern aspects of this important branch of ship's work must have for the service, especially as such information is not readily accessible otherwise. I hope also, it may be of help specifically, to some of the many young officers destined to be assigned as paymasters of our vessels. These officers will have to confront situations involving principles and details which are new to them, but which have been worked out many times before. The experience of predecessors " at the work bench " ought not only to be of aid to follow, but to build upon and improve. There is much in our work which is yet susceptible of great development. The experience of the past or of the present cannot be considered the last word on the subject by any means.

The only qualification to which I lay claim, in setting down this experience, is as an old hand at ship's pay department work. In fourteen years' service, over eight have been spent as head of that department, on vessels of military type engaged in active cruising and operating under conditions of both peace and war. The rest of my service has been largely spent on duty directly connected with the fleet.

Fourteen years have seen many changes in the pay officer's work at sea. The general mess system has made its appearance and taken its place as an indispensable element of the ship's organization. The ship's store has come into being, and changed from

co-operative to government control. Methods in the issue of clothing, and in accounting for it, have been wholly changed. Office routine and accounts have been revolutionized. Finally the general storekeeping system afloat has been established, and bids fair to follow the general mess in being recognized as a necessary integral element of the ship's organization.

The modern cruising ship usually has but one pay officer. He is the head of the pay department, as the ship's department representing the Bureau of Supplies and Accounts is designated. As such he is the general storekeeper, commissary officer, officer in charge of sales stores, and disbursing officer of the vessel. The pay clerks and enlisted force allowed him to discharge these functions, constitute the pay division of the ship's company, over which he acts as divisional officer. The character of his duties thus indicated divides them into four categories. The general nature of these duties are quite clearly indicated by naming them alone, and it is the purpose of this article to take up only the duties of the pay officer in his work as the ship's general storekeeper.

As general storekeeper the pay officer is charged with the maintenance on board of a proper stock of all supplies, Title X, and of the proper outfit of equipage, Title B. All equipage in store, that is not in active use about the ship, is in his direct care and custody. Equipage in use is accounted for through information furnished him by the heads of the ship's departments representing the various Bureaus which are using it. In this way, as far as the Bureau system will permit, equipage and supplies are treated alike, the accounts therefor being kept under one officer, and made the subject of one set of returns.

The only titles with which the ship's pay officer has to do in his capacity as general storekeeper are Titles B and X.[1] All public property on board, with the exception of provisions, clothing, medical and marines' stores, and coal and ammunition, is included under one or the other of these titles. The articles excepted are accounted for, either by him or by other officers in special manner, mainly under Title Y.

NOTE.—The writer wishes to note, while the methods and forms described under this section accord with existing orders and regulations, they are too recent to have been formally approved beyond the Pacific Fleet. Except when specifically advanced as theory, everyone here recommended,

[1] For titles of articles see General Orders 78, 79, 121, and Bu. S. & A.'s Instructions file nos. 112568, 112570.

however, has been tried by him and found practicable. Ideas have been adopted from many sources. In particular, those of Pay Inspector T. H. Hicks, U. S. N., have been numerous and valuable. The full co-operation of the officers of the *Colorado* and the enthusiastic interest and work of the enlisted men of her general storekeeping force have been of the greatest assistance in developing the system.

Title B covers the outfit of the ship, the movable equipage. This is furnished by the bureaus on her commission, and is maintained by them. Supplies necessary for her up-keep, other than this permanent outfit, are put on board under Title X, and drawn and paid for as needed by the officers representing the bureaus from the sums allotted them for such expenditures by the bureaus. The official distinction between equipage and supplies is an artificial one. Equipage is that part of the stores used on board which the bureaus wish accounted for after issue. They do not permit equipage to be expended except after survey, *i. e.*, an impartial investigation by disinterested officers as to the reason and responsibility for damage or loss. Supplies are those items which for various causes the Bureaus do not wish to follow into use, and which, therefore, are expended on issue and without survey. This distinction in practice is made closely to correspond to the natural difference between items which do not immediately merge into others or disappear in use, and those which are consumable, that is, do disappear when so treated. Illustration will make this clearer. Furniture, flags, tools, band instruments, etc., are equipage, the disappearance of which must be investigated and accounted for. Paints, packings, nails, cleaning paste, are supplies which lose their identity in the item to which applied, and thereafter are not considered separately from it. This distinction between equipage and supplies creates differences in their treatment. Since equipage is followed into use, it must be accounted for under the different bureaus until finally worn out. Supplies being expended as drawn have merely to be considered while held in the Naval Supply Account, with provision that proper re-imbursement to it be made on issue. The result is, all supplies on the general storekeeper's books are "in store" under one account. while equipage may be either "in store" or "in use," and is carried with a separate account for each bureau.

These differences, while they naturally make advisable consideration of each title separately, do not affect the fundamental prin-

ciples governing the procurement, custody, and issue of stores for the service ashore or afloat. These principles may be embodied in certain axioms which should guide all general storekeepers, particularly those afloat, where space and conveniences for the conduct of their business is limited. Let us give emphasis to these axioms by listing them.

SHIP STOREKEEPING AXIOMS.

Don't run out of any item of stock except by design. Conversely, don't overstock.

Don't let stock get hidden away. Stock "out of sight is out of mind."

Don't let stock deteriorate. Every moment spent in furbishing and making it attractive to issue saves hours of criticism and explanation later.

Don't make it hard for authorized persons to get stores. They are kept on board for use and should be as accessible as possible.

Don't employ any methods save those which will minimize errors in recording issues and receipts.

As with all axioms, the truths these express seem trite. But unless they are kept steadily in mind and applied to every situation which presents itself, the storekeeper will often find himself far afield.

STOREROOMS.

The application of these axioms, for instance, meets us at the first turn we take into our subject. They result in certain fundamental necessities in the location and equipment of storerooms. These also may be tabulated into: (a) *concentration* of stores on hand to the limit possible; (b) *visibility* of all stock in storerooms; (c) ready *accessibility* by all departments.

Concentration of storerooms in the same vicinity is obviously necessary from several points of view. One with any experience with stores realizes that a correct inventory is exceedingly difficult when they are scattered. Keeping track of issues, or of excess or depletion of stock, is difficult also. Nor are scattered

stores, not under constant observation, likely to receive proper care.

The ideal arrangement to be approximated as nearly as possible in practice, is for all ship's storerooms to be interconnecting with B in one series, X in another, and with a common center for the issue (and receipt) of stores. In the design of the vessel, assignments, to more important military functions, usually prohibit the location of *all* storerooms together. In this case the best division provides for all those for supplies, together, leaving equipage to be similarly concentrated elsewhere. On the large, older ships, Title X usually can be concentrated in an after set of compartments, and Title B in one of the forward sets. Where it has not already been done, even this arrangement will involve considerable reassignment of spaces and work in shifting stores; but the results amply repay the labor.

EXCEPTIONS TO CONCENTRATION.—By reason of special characteristics some supplies are not subject to concentration in storerooms which can contain the rest of the stock. These are: inflammables, which must be kept on upper deck; lumber, bar metals, and piping, the length of which sometimes limits the choice of place to stow; heavy cordage and wire also, on account of its bulk and weight; lubricating oil for the main engines, usually carried in too great bulk to stow with other stores; and paints and oils, which usually have a separate locker specially fitted, provided for them.

The concentration of stores brings with it the possibility of the use of one set of storemen, each of whom is competent to answer any call, and who by standing regular watch can keep the storerooms open for business night or day. This is an important consideration as will be seen later; so important that if X and B have to be divided on a capital ship, it is worth while to have a gang of storemen detailed for each set of storerooms.

With storeroom space concentrated, it is well to have each set arranged with but one entrance to give on a small clear deck space available for use by customers while waiting to be supplied, and as a receiving floor to hold items coming into store, pending inspection and identification with invoices and stock numbers. The station of the storeman on watch is at this entrance, and all customers should be prohibited from going into other storerooms

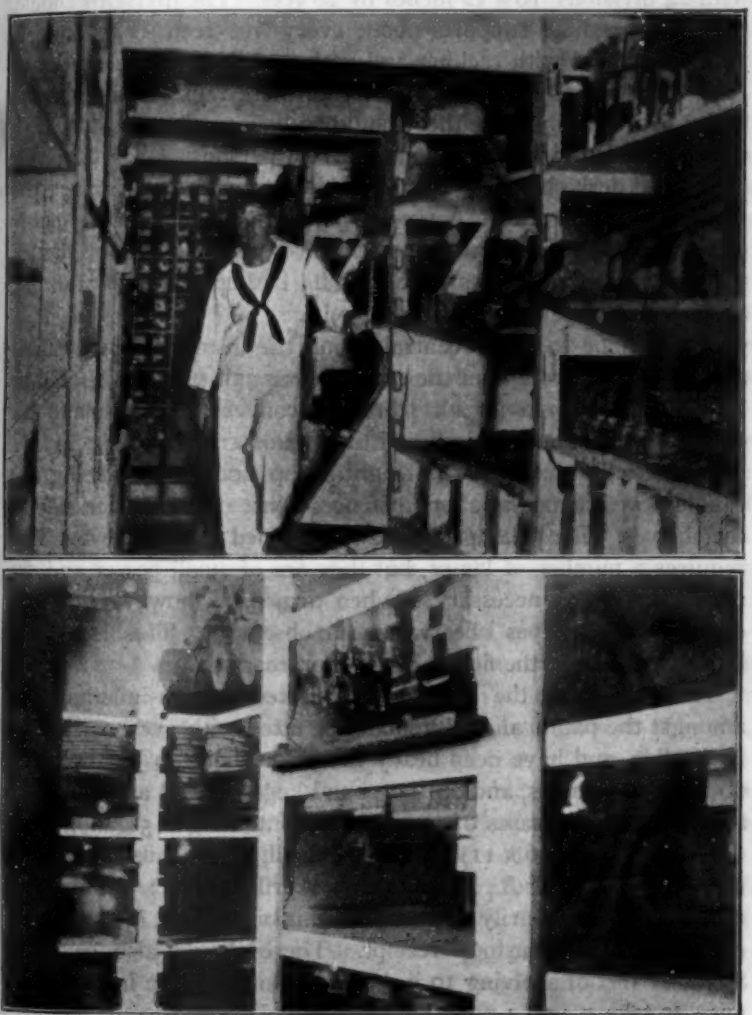
unaccompanied by him. This is found advisable to keep the stock from being handled and disarranged.

Visibility of supplies in storerooms, when concentrated, should govern their interior arrangement. Many ideas of the past with regard to storeroom fittings must be disregarded. Storemen used frequently to cover stock as much as possible in cupboards, drawers, deep shelves, or out of the way storerooms, in order to stand a good inspection on the strength of paint work and shellac. The slightest personal experience in keeping stores is convincing that fewer mistakes in reporting stock "all gone," and omissions in the proper care of stock occur, when it is constantly in sight. These lead to the revision of usual fittings as follows:

MAIN STOREROOMS FOR TITLE X, as far as *general characteristics* are concerned, should be as large in dimensions as the structure of the ship will permit. Unnecessary bulkheads, either of metal or wire mesh, should be banished. A straight lead with as large a hatch as possible should be provided from the open air to the receiving floor to facilitate taking stores aboard. This is usually a rush operation, with comparatively large quantities of stores to be handled. Connecting doors should be as large as standard fittings allow. Decks should be of bare metal. Grating or floor boards are unnecessary and hard to keep clean. Except in the receiving room, shelving should all be open from floor to the deck above, and should extend around all walls. Little floor space should be free. Most of it should be taken up with shelving arranged in stacks with narrow aisles between. Main passageways should, of course, be kept clear. Storerooms should be thoroughly lighted, so that there shall be no dark corners whatever. To accomplish this, small lights should be placed about and under the shelves. Switches at the entrance to storerooms will enable lights to be turned off when the room is not in use.

Special fittings for Title "X" storerooms, as far as developed on one capital ship with its supplies concentrated, may be enumerated here. A total of 700 linear feet of shelving is enough, if it averages 20 inches deep, with 12 to 18 inches clearance. Twenty-seven inches between stacks is as narrow as convenient. Suitable pockets for small articles should be made in movable units, with the partitions between them removable, so as to vary the size of the pockets to suit the stock on hand.

For electric bulbs, drawers, with false bottoms perforated to size of bulb. For glass and thin sheet metal, one rack with 20



VIEWS IN THE TITLE "X" STOREROOMS.

Note the open character of all shelving, the small lamps under the shelves, the battens to secure for sea, and the stock tags.

pockets. A glass cutting shelf, 44 x 44 inches should be fitted near the glass rack, so arranged as to slide back out of the way when

not in use. For heavy sheet metal, one rack 19 inches between uprights four feet apart. For bar metals and tubing, four racks with 24 divisions, 10 x 12 inches by 20 feet. The divisions should have intermediate supports about every five feet. For lumber, two racks fitted with racking and with outside measure 6 x 6 x 19 feet. It is usually necessary to locate these racks on one of the upper decks; in this case they should be inclosed in a locker which can be secured to keep out unauthorized persons.

A small desk should be located in the receiving room where the storeman keeps watch. A six-compartment metal file case handy to the desk is convenient. These fixtures can be used for the set of standard specifications which should be kept in the storeroom, or for other papers needed.

A telephone to ship's central should be installed at the storeman's desk. Throughout the storerooms small supports should be fitted to shelves to permit storeman conveniently to make his entries on chits at the place and time items are issued.

A most effective method of lighting up stock is by placing five candle power lamps at short distances apart on the under side of the shelves. These lamps should be screened from the eye. This requires a number of lamps, but they are of small power and are not lit, except as necessary. When turned on, however, no part of the stock escapes obesrvation in obscurity. This is a most important item in the fitting of the storerooms.

The section of the storerooms devoted to non-inflammables, amongst the paints and oils, should be fitted with overboard drain if possible, and have deep heavy racks for about 80 5-gallon tins, 60 10-gallon drums, and 80 100-pound kegs, as well as clear space to pile about 210 cases of engine oil (containing 2 5-gallon tins) dimensions, 21 x 16 x 11½ inches over all, or an equal amount in barrels. (Bu. S. & A., letter 104206, April 3, 1912.) Limitations of space will ordinarily require that this oil be kept in the engine compartment on custody receipt. There should also be about 80 linear feet of shelving 10 inches deep, and with 12 inches clearance, to take 1- and 3-pound cans of mixed colored paints, etc.

Such special equipment as necessary to aid in speed and accuracy in the issue and care of stores should be installed, such as dial spring scales, at convenient points, and small power driven metal saw near the metal rack. An electric hand buffer for keeping metal bright should be furnished also. Lockers should be provided

with space for each of four storemen to keep a change of clothes, so that in doing dirty work he may shift to dungarees.

RESERVE STOCK STOREROOMS.—Except in an ideal arrangement, all stock (other than the items whose characteristics forbid concentration), cannot be carried in the main series of storerooms. This will require subsidiary compartments to act as feeders. These in general should conform in fittings to the foregoing description.

The locker for inflammables, paints, and oils required kept on deck, should be fitted for bulk stowage of five-gallon tins and ten-gallon drums, should have an overboard drain, and specially strong compartment for alcohol, which should be fitted not only with an ordinary lock for the storemen, but with a combination lock, which can be opened only by the master-at-arms, or other person authorized to draw alcohol for the ship's use. All lockers exposed to the open air should have inside locks rather than padlocks, as the latter deteriorate rapidly with weather, washing down decks, and scrubbing paint work. I am not in favor of the use of tanks for inflammables. They are hard to keep clean, and waste room where space is valuable. A tank with but an inch of liquid in the bottom is lost, as far as the rest of its stowage is concerned.

Accessibility to stores is, after all, the prime object of concentrating them and making them visible, as indeed it is the main reason for their presence on board. The location and fittings of storerooms, as well as the methods in arrangement of stock, consideration of which follows, should all converge to make it as easily and certainly accessible as practicable, for all having to draw upon it. The telephone connecting with all parts of the ship through central saves much time. Where storerooms are deep-lying, a routine for the delivery of stores to the points needed will also help. A mechanical means for delivery, such as a small hand lift to a central point of the decks above might be advisable.

SUPPLIES (TITLE X).

STOCK.

The application of our fundamental principles to the receipt, care, and issue of Title X stock afloat produces interesting results. Having storerooms in as satisfactory condition as pos-

sible as far as location, arrangement and fittings are concerned, the general storekeeper can next turn his attention to the stores themselves. His consideration of this subject may be divided into having these: (a) most concentrated; (b) most accessible! (c) maintained in proper quantities; (d) in proper condition; and (e) most accurately accounted for.

Concentration of stores within the limits of a storeroom is no less important than concentration of storerooms. All items of the same kind should be put together. One unacquainted with former conditions would be surprised at the way stores used to be scattered about a ship. Radical measures were needed to bring the separate bureau stocks of supplies together to conform to this simple and obvious idea.

The classification of all navy stores under 65 classes has been a great aid in arranging them afloat as well as ashore. The "Indexed Classification of Naval Stores and Material" is the official publication which lists alphabetically, and with remarkable completeness, the names of all items used in the service. It indicates for each whether it is B or X, and in which class it belongs. The division of classes is along natural lines; so that one soon learns the class numbers.

ARRANGEMENT BY CLASSES OF SUPPLIES in the storerooms is made convenient through the use of this classification. This arrangement splits the stock up into more intelligible and manageable units. The characteristics of some items prevent placing all the articles in one class together, but separating them should be the exception and not the rule. Such exceptions, however, are: Class 8, gasoline; Class 12, oars, boat-hooks, squilgee handles; Class 13, cotton waste, grate bars; Class 14, kerosene, engine oil; Class 21, heavy cordage; Class 22, heavy wire cable; Class 38, brooms; Class 39, lumber; Class 44, metal piping; Classes 46 and 48, bar metals and angles; Class 50, fire-brick; Class 52, inflammable paints; Class 65, fresh water. In most of these cases the reasons are obvious why the items cannot be put on the shelves or in the bins with others of the same class.

ARRANGEMENT ALPHABETICALLY, in each class should follow segregation by classes. This is done with the aid of a device, the importance of which from the standpoint of celerity and certainty of issues can scarcely be over estimated. This is the use of a stock number system. Each item in stock is given its special numeral

in a series of self-indexing numbers. The best series for this purpose is one similar to that used for standard specifications by the Bureau of Supplies and Accounts, in which the numbers indicate not only the class but the initial of each item. By its use, items in many classes can be so arranged that, knowing either the class number and name, or stock number only, any one article can be instantly found, even by a person unacquainted with the storeroom. Items in general follow in regular sequence of stock numbers. In the comparatively few instances pointed out above, or when considerations of increased visibility and accessibility cause slight breaks in this sequence, samples or tokens are placed in order, tagged with the needed information as to where the stock may be found.

A stock number system, such as just referred to, has the following characteristics and advantages: The first figures in any stock number are those of the class to which the item belongs, as shown by the Indexed Classification. Then follows the initial letter of the correct name of the item. Finally come the arbitrary number (representing its place alphabetically, or by size, etc., in series from one up) of the item amongst others of the same class and initial. Sometimes there are too many items of one class and initial to permit an interpolation, without changing the last figures of many stock numbers. This is so with screws, for instance. There may easily be 180 separate kinds of these on the shelves. If they ran from 42S1 to 42S186, and it were necessary to interpolate a new item in the first ten of the numbers, it would mean changing the 160 odd stock numbers after the one inserted. This condition may be avoided without making the number system too complex, by adding distinctive letters after the initial letter. In the comparatively few cases required, this will effect a further sub-division of the class, so that the final series of numbers will seldom run up to more than thirty. Thus, interpolation need never be difficult to make, either in ledgers or arrangement of stock. To illustrate: 5B5 is bunting, white, 19" ; 12H23, handles, squilgee; 15W19, wire lampcord; 33P13, packing, flax, square, ⅞"; 42S1, sockets, for table legs; 42SMR10, screws, machine, round head, brass, ½", .011; 65W1, water, fresh.

The advantages of this system of numbering are: (a) it identifies items with certainty for all using it, and avoids the errors and confusion arising through the use of names; (b) it provides

means for interpolating items in the number system in place by class and initial; (c) it indicates the class and name to every one in the storeroom force; (d) it permits ready arrangement by storemen of items by class and number, without reference to ledger; (e) it helps to index the stock in storeroom as well as on the ledger.

Accessibility of stock as a term embraces all that relates to making stores as easily obtainable as possible by those needing them. To those who may be inclined to make their stock system so complex as partially to nullify its object, which is simplicity in issue, it cannot be too often reiterated that stores exist on board for issue, and for no other reason. The maximum of concentration in locality serves accessibility in reducing uncertainty where to go on the part of those needing stores, and in saving time after getting there. This doctrine has been carried so far already, on one ship at least, as to provide for the delivery of stores at the point of use rather than in the storeroom. On that vessel a delivery service, using the telephone and the legs of unimportant men to save time of important ones, is in full operation. The telephone connection with all parts of the ship makes intercourse easy as to stock. The storeroom, open night and day for business, breeds confidence on the part of all concerned that there will be no hitch in getting stores as they want them. This last is of such practical value that storerooms should not be permitted closed at any time, except by the explicit permission of the general storekeeper.

It should now be apparent why such pains should be taken with the arrangement of stock, and with providing means so that any storeman on watch will be able to lay his hand on any item with the least possible difficulty and loss of time. Some systematic arrangement is essential. The most obvious method is to have the stores arranged by classes, and alphabetically in each class, as described under "Concentration." In this order, all items should be represented by a part, if not all, of the quantity in store on the shelves. Where the whole stock of any article cannot find place in the main storeroom, the portion outside should be considered and called "reserve stock," and the compartments containing them, "reserve stock storerooms." These reserve stocks should be used as feeders to the shelves in the main storeroom, otherwise a waste of the time of both customer and storeman will occur in

leaving the main storeroom to go perhaps to a distant part of the ship. Where even a part of the supply of an item cannot find place on the shelves, a sample with stock tag should be placed in regular order in the main storeroom stock, so that at least any question as to stock number, location, identity or suitability of the item wanted can be settled before going elsewhere for it. If, as in the case of inflammables, even a sample is not permitted in the storeroom, a token with a tag bearing its stock number and location should be in proper place.

To those unacquainted with present navy conditions, these provisions may seem a theoretical and even absurd refinement in stockkeeping. I can assure such from actual experience that, aside from the desire to perfect the system, an immediate practical consideration exists where stores are concentrated so that all departments have to be served from a common source. The ordinary busy day on a large ship requires every device to promote ease and certainty of issue. Unless all such are provided, the storemen, being human, will make errors and let things go. It is bad enough to have to say of an item, "all out of it," as must be done once in a while, but many times worse to say it when the stock is on board, but in a place unknown to the storemen. This will happen frequently, unless all the sign posts are up. I go so far as to mark on the edge of the shelves where the stock *ought to be,* as well as tag each item of stock, and I think it pays. For example, with items 12-D-1 to 12-D-7 (various types of dogs for water-tight doors and hatches), besides having a typical dog of each kind tagged with its proper number, the shelf bearing them is marked with the legend, "12D1-12D7." For any reason should it be necessary to stow 12D8 elsewhere in the main storeroom, the shelf proclaims "12D8, upper platform, forward port." If 12-D-8 must be kept in reserve stock storeroom, and is therefore not immediately accessible, a sample with a tag exhibits the item in its proper order, and reiterates the direction of the shelf as to the whereabouts of the main supply.

Maintenance of stock involves the axioms, "Don't run out of stock," and "Don't overstock." The allowance lists of the various departments of items in Title X, inherited from the former system, are only approximate guides. These lists were originally compiled in Washington. They fixed unvarying and rigid limits to the quantity of each item which could be consumed

by the ship during the period of allowance. Such allowances could not be expected to fit various conditions in cruising, age of ship or character of heads of departments. The inevitable deviation from allowances were taken care of through supply under "in excess" requisitions. On the other hand, excesses in allowance were rarely reported. The tendency therefore was constantly to increase the number of items in the allowance, and to accumulate unused stocks of unnecessary items.

The present system is much more practical and flexible. The department fixes an allotment to cover the quarterly expenditures of each department on board each vessel. Any stores named in the old allowance lists *in any quantity* may be drawn and used by them during the quarter up to the value of these allotments. This provides for the variations in the ship's requirements, while attaining the department's object of supervising and limiting her expenses. Extra demands are covered by a request for addition to the current allotments, this corresponding to the "in excess" requisition of former times. Incentive to economy is furnished by the publication, from time to time, of the comparative tables of the cost under Title X of the ships of the fleet, grouped by types to make the comparison more conspicuous.

From this it will be seen the past issues of any item of supplies on a ship furnish a better guide in maintaining stock than allowance lists, especially if the former are corrected by information as to any contemplated changes in policy or material, obtained from the ship's departments.

In no part of his work with Title X is more delicate judgment required of the general storekeeper than in this. Therefore, he should make it a practice not only to note, but to scrutinize every item of each requisition submitted for his signature. In addition, when getting ready for cruise, he should make sure that the stock is gone over, item by item, for the purpose of preparing requisitions for sea stores. In ordinary times, every precaution should be taken to have the alarm sounded when the "low limit" of stock on hand is reached in any item. Every stock tag should have this "low limit" on it, so that the storeman, making the issue may see it and compare it with the quantity left on the shelf. Every stock ledger card should be similarly marked. In the one case, the storeman notes the need and starts the routine replenishment by sending in a "Storeman's Request for Stock" (see

Form 1 following) to the general storekeeper's office, and in the second, the office itself notes the need and initiates the requisition in case the storeman has overlooked it. In addition, the general storekeeper himself should constantly select for inventory, at random, items which are much used, to see whether the proper action has been taken. Often with all these precautions he will find the storeroom caught occasionally with none of a needed item in stock. Then his only recourse is to a quick transfer from the supply ship, or from other vessels in the fleet with stock to spare; or finally to an open purchase before the need becomes too acute.

On the other hand, to be efficient, stock must not be kept in too great quantities, "to play safe." Otherwise the storerooms, which can never be expected on shipboard to be entirely adequate in size, will be congested with a confusing quantity of slowly deteriorating

Form 1

Date..... No.....

STOREMEN'S MEMO. REQUEST FOR STOCK

Quantity		Article	Stock No.
Required	On Hand		

material. The important bearing of concentration and accessibility on this branch of the subject may be easily seen. The more stock is subject to daily picking over, the more likely its depletion or undue accumulation is to attract attention. But with all precautions, the only rule which can be followed with any success in the maintenance of stock is that of eternal vigilance.

Custody of stock from the general storekeeper's standpoint, means all that pertains to the care and condition of stock while "in store." This is a subject still in early development, as far as ships are concerned. Under the former system, the storemen only too often gave practically no care whatever to stores. When received, they were frequently bundled into drawers, or cupboards, or remote stow-holes, and left to themselves till brought forth for use. or turned in when the ship went out of commission. Surveys were common of material which had never

been used. Responsibility was difficult to locate, because usually the discovery of the damage or loss was much belated. Stores accumulated in odd corners, forgotten. In one case the general storekeeper on taking inventory on a large vessel, reported finding enough slate color paint on board to completely repaint the ship outside more than twenty times.

Numerous like instances could be cited, but this is enough to make manifest the aid given concentration, visibility, and easy access to stock in questions of custody. In plain view, in an orderly storeroom, stock can scarcely deteriorate without being conspicuous. Bars with verdigris, cans which leak, the ravages of moths or rats, all become plain. Perhaps the device of lighting every dark corner of shelves has most effect automatically on the care of stock. With well lit shelves, the storeman will have good looking stock on them.

Experience has proved, apparently, that it does not require technical experts drawn from other departments to take care of items in store, particularly Title X. It is well to call their specialists from time to time to look over stock and make suggestions towards improving its condition, but my experience is that, in general, better results are obtained by the use of men of lower rate for actual storeroom work, than petty officer specialists. The former, if he has a natural liking for the work, will put real interest and enthusiasm in it, while the latter is apt to be apathetic, especially under present conditions, when he sees no chance of promotion, but rather conceives himself as in a backwater of his business. I have seen not only the current work satisfactorily handled, but much real progress in rearrangement made by a Title X storeroom force, composed of two firemen, second class, and one ordinary seaman; at the same time the Title B storeroom keepers were one fireman, second class, and three ordinary seamen. The fact is, that except in very rare instances there is no magic in taking care of stores. With intelligence one can either see for himself, or easily find out, how it should be done. It should not be understood, however, that such men can be kept permanently interested or contented in these rates. There undoubtedly should be some means provided for the promotion of men who show themselves specially adapted to storeroom work, in order to keep them in it.

As hints in the custody of Title X stock, the following may be given. Bar metals should be painted on end with distinguishing colors, as indicated in Bureau Memoranda (p. 987), and instructions given to issue from unpainted ends of bars. Bright steel should be kept bright with electric hand burnishers. Barrels of cement, fire-clay, and light dusty articles should be kept in canvas bags made for the purpose. These items should be obtained from the storehouse in tins if possible. Rubber and rubber compounds should be in cardboard boxes, or wrapped in paper to exclude light (see Bureau Memoranda, p. 1930). Waste in bales, should be isolated in a small separate compartment, on account of the chances of spontaneous combustion, and, if received wet, should be given a chance to dry before stowing away. At sea, by routine, battens for shelves should be put in place in preparation for possible bad weather. In port, the battens should be removed the better to expose stock. A sufficient supply of paper bags, bottles, cardboard boxes, etc., most of which can be obtained from the canteen, should be kept in the storeroom for use in making issues. At all times items should be arranged on shelves as symmetrically as possible to permit storemen to gauge the quantity left on hand, at a glance, on making an issue.

Accurate accounting for issues and receipts. Primarily the accuracy of stock ledgers depends upon the storeman. Every aid should be given to make the storeman's work in this respect certain and easy. If he does not check receipts, or report issues correctly, the ledgers will soon cease to reflect actual conditions.

IN ISSUES OF SUPPLIES, the most usual causes of errors in making and getting them properly posted, arise in identifying what the chit calls for with what is actually issued on it.

Errors in nomenclature are commonest. If stock is dealt with by name only, confusion arises. Different persons will call the same article by different names. The difficulty first suggested the system of stock numbers already decided. A sample of every item in stock should be marked with its number. This is commonly a 1½ inch circular, metal-rimmed tag tied to one of the units on the shelves. In some cases, such as on plate metal, tin, or glass, pasters must be used. The storeman works by this number. All chits calling for items (Form 2 or 2a), and originating in the ship's department, are provided with a column for the storeman to enter stock numbers from these tags or pasters, as

the issues are made. As the ledger sheet bears the same number, any chance of error in posting through confusion in names is thus avoided. These stock number tags can be made to serve other purposes as apparent below.

Errors in confusion of units of issue are avoided by marking on the stock tag the proper unit as it appears on the ledger, "No.," for number; "ft.," for foot; "lb.," for pound; "doz.," for dozen,

Form 2

U. S. S. COLORADO

Supply and Accounts Department .....191..

Issue to.....

Item No.	Quantity	Unit	ARTICLE

Do not fill in first column
Do not erase or interline Purpose.....
Put only one article on each line
Write plainly and give full description .....
Person authorized to sign chit

Form 2a

Stock No. 1	Quantity	Unit	ARTICLE	Unit price 5	Extension 6	

U. S. S. COLORADO, Equip. Steam Eng. .....191..

Issue above to....., for.....
(Purpose)

Do not fill in Columns 1, 5 and 6
Put only one item on each chit
Write plainly and give full description .....
(Person authorized to sign chit)

as the case may be. The storeman changes the chit if necessary to accord with the unit on the books. For instance, a chit calls for 2 ft. ¼ inch brass rod. It reaches the stock ledger yeoman with the entry by the storeman, "44B2, 1¼ *lbs.*" The stock tags should also have entered on them the low limit of the item, so that in looking at the tag the storeman takes in with his eye not only

the stock number he desires, but, if the stock is properly arranged, the quantity on the shelf, and the fact as to whether it is getting low. To avoid confusing the eye, entries on stock tags should be as few and plain as possible, and all on one face of the tag. The only other data I personally permit is in the case of reserve stock. The few tags concerned bear in red ink "RS," to indicate they are of this character; and in the same color, the number of the compartment in which the stock is located.

Errors in quantity issued are also to be guarded against. If less or more than the chit calls for, storemen should be strictly enjoined to change the chit to accord with the actual quantity delivered. Men from other departments calling for stores should not be depended on to see that chits are so changed. Scales and measures should be kept in all places in storerooms necessary, to make it as easy as possible for the storemen to get the actual data, otherwise they will guess. Even with all these measures the running inventory, described later, will develop differences in ledger and stock.

To illustrate the errors which the employment of stock numbers and the precautions outlined, are constantly eliminating, the following are selected practically at random from one day's chits. First the description of the item as written by the ship's department is quoted; then, in italics, storeman's entry:

"1 Bucket fire clay.....*25C1, 25 lbs.*"
"1 Bottle mucilage.....*53-M-2.*" (This No. is the small size bottle.)
"2 Screw eyes, iron.....*42SE2.*" (This No. shows that brass, not iron, screw eyes were issued.
"1 Gross wood screws...*42SWF16.*" *Issued 75 No.* (screws wood, flat-head).

Issues without receipts. The primary principle to be instilled in the storeroom force is that no stock whatever is to be issued except in exchange for a chit, signed by an authorized person. The commanding officer should determine who are to validate chits in each department. A list of these persons should be posted in the storeroom, and any chits turned in by a storeman not properly signed, returned to the latter for explanation.

Nearly every rule has its exceptions, however. After inculcating the importance of securing chits to cover all issues, it is necessary to instruct storemen that in times of great emergency stock may have to go out without waiting for a chit. In this case

they are immediately to report the facts to the office, and endeavor to get the necessary paper as soon as the emergency is past. When this class of issues may be made, must be left to the storeman's judgment.

There is another class of exceptions to this rule. Insignificant items as to value are occasionally wanted from the storeroom, such as, a two-inch square of tin, a single nut, a few tacks. Such needs are not worthy of the machinery involved in ordinary issues. They are too small to require the formality of a chit, and inclusion in the weekly stub. If not frankly recognized, there is a chance that these issues would be made by the storeman as an irregular favor. So he is provided with a common sense way of

Form 3

FORM FOR "ISSUES WITHOUT CHITS" BOOK, TITLE "X"

Date	Quantity	Unit	Article	Stock No.	Department	Sig. of Drawer	Value

Instructions to Storemen.

Enter *without fail* any issues of very small value made without chit to cover. No issue to be worth more than ten cents. Fill out each entry complete.

GENERAL STOREKEEPER

handling such instances, through an "Issue Without Chits" book, in which entry is made of insignificant items not covered by chit, to whom issued, and for account of what department. These entries should be initialed by the person receiving the stores, so that when the value of such issues becomes material, if it ever does, it may be covered by a special receipt from the department concerned. Form 3 suggests ruling for an "Issue Without Chits" book, and instructions for its use. In practice I have found this device little used, but a great convenience when it is employed, and it keeps storemen on regular ground.

Issues of exact quantity desired are to be encouraged. Storemen, to save trouble, to keep the stock looking better, or for other plausible reasons, are apt to issue out full packages only, such as a carton of screws, a full sheet of metal or glass, or a tin of

kerosene, when only a dozen, a square foot, or a gallon respectively, is wanted. In single instances, it may seem trivial to break a small package for an issue. There is a good reason, however, for insisting on exact adherence to the rule. Parts of items so drawn and not issued must either be stowed somewhere where they don't belong, or thrown away. Commonly they will be kept in out-of-the-way corners, "Magpie hoards," unaccounted for because already expended, until they get scattered, or disappear, or are finally swept up by some new broom and returned to the storeroom the worse for their experience. The only proper method is to leave the broken packages in the storeroom where they will still remain on charge and available for issue, and discourage the accretion of private stocks of supplies about the ship. Therefore, it is well to emphasize to heads of departments the desirability of drawing only what is needed for immediate use, and insist on the storeman strictly keeping to the rule of issuing exactly what is called for by the chit. An exception, more in seeming than reality, to this rule may be made in the case of cleaning gear, issued weekly to the different parts of the ship. This finds definite stowage in regular assigned places and is inevitably used up. But even such issues should be limited as far as possible, otherwise, when the end of the quarter comes, the departments will find they have stock to turn in for credit, under the order requiring this to be done with all items not to be immediately used.

Consideration of issues, as far as the storeroom is concerned, may be concluded by referring to Form 5 containing a typical set of orders to govern Title X storemen in making issues. It is essential these rules be strictly followed, or as stated by them, "both stock and books will soon get in a bad way."

Form 5.

U. S. S. COLORADO.

RULES FOR TITLE X STOREMEN'S ISSUES.

1. *Absolutely nothing* will be issued from this storeroom without a chit, signed by proper authority, except as indicated in following paragraph, and in cases of actual emergency. In emergency, storeman will report the issue without chit immediately to the office, follow the matter up, and get chit to cover at the earliest possible moment. Report to the office when it has been obtained. Nothing will be issued on chits not having the name of the person receiving the stores.

2. Make no "issues without chits" except of *insignificant* items, nor in any case of value exceeding ten cents. When made, post them promptly in full in the Issue Without Chits book.

3. Before filling chits, storemen will see that they are properly dated and signed. As the article called for is taken from its place, *look at* the stock tag, noting the correct stock number, the unit of issue (whether by lb., gal., yd., ft., doz., etc.), and the *low limit*. Do not *guess* at stock numbers, or put them on from memory; but *always look at the tag*. If the tag is lost, get another from one from the stock ledger yeoman and tag the stock at once. Put the stock numbers and your initials on every chit, as well as make any changes required on it, to have it represent *exactly* what was issued. *This must all be done before anything is issued to another customer.*

4. When the weight or measurement of any article delivered is different from the quantity called for by the chit, the person receiving it must be informed without fail of the change made.

5. Whenever possible, enough stock is to be kept on the main storeroom shelves to make all ordinary issues without leaving the storeroom. In cases where a reserve supply is kept in reserve stock storerooms, use slack times to fill up main storeroom shelves from the reserve. Where there are only samples of items in main storerooms, use sample to get stock number, and when necessary to make sure if it is the item wanted. Useless trips may thus be avoided.

6. Where a low limit is reached, make out immediately a Storeman's Request for stock, and give it at once to the stock ledger yeoman. Mark the request, if it needs special attention, or always if the stock has run out altogether, with the word "*Important.*" *Never get below the low limit if it can be helped.*

7. Make no issues to another ship without authority from the office. In such cases get a receipt bearing name, rate, and ship, from the person receiving the article.

8. *Remember,* no case except actual emergency justifies lack of care in carrying out this routine *exactly*. The accuracy and condition of title X depends, first of all on you, and if it is not followed strictly, both stock and books will soon get in a bad way.

Paymaster, U. S. Navy,
General Storekeeper.

RECEIPTS IN TITLE X originate in two ways. Ordinarily, when the low limit is reached, the storeman reports on a Storeman's Request for Stock (Form 1). This form is printed in duplicate on a perforated slip so that a carbon can be retained by the storeman to prove he took the proper action in case of subsequent inquiry. The requests are numbered consecutively. The numbers should be carefully noted in the office to prevent any straying before being given attention. If the storeman has any remarks

to make concerning an item appearing thereon, he should enter them on the face of the request, such as "big issues coming," "stronger cartons needed," "should be asked for in gallon bottles," "Jones says no more wanted." He also enters his estimate of the quantity which should be required for, though this is finally decided in the office, after consulting the stock ledger, and perhaps making further inquiry in the departments.

Stock may also be replenished through direct action by the office. The scrutiny of the ledger in posting expenditures, an independent investigation, the request of one of the ship's departments, or orders, may originate a requisition in this way.

It is usual, and the only safe course, in preparing for a cruise, to go over the Title X stock item by item to make sure that nothing is overlooked. It is well for the general storekeeper to have representatives of the department most interested do this with him, as the process elicits much valuable information as to the work planned by them for the future and its special requirements in the way of stock, which might otherwise be left to the storekeeper's imagination.

The head storeman should be furnished with a copy of all requisitions, with stock numbers entered thereon. New items are assigned stock numbers as soon as required for. This copy is used by him to check delivery slips, and the actual stores covered by them as they arrive and are laid out on the receiving floor. Items should not be taken from this floor until they have been satisfactorily identified, checked and inspected. Then only may they be melted into the stock. A practical advantage in enforcing this rule occurs from the fact that thus laid out, this new stock is usually unsightly and in the way, and so tends to hasten action on the part of the storeman in getting it inspected and checked. The storeman should be particularly careful when supplies of technical nature are received to have them passed on by someone detailed by the head of department concerned, who will "O. K." and initial the shipping memorandum or delivery slip, for record in case of any subsequent criticism.

On arrival at a yard, arrangement should be made for general orders to yard storeman, and men in charge of shops in the manufacturing departments to issue no material for the vessel, except to a duly authorized representative of the ship's general storekeeper. This will prevent its coming on board without the latter's

knowledge. This is especially important with items manufactured in the yard which are apt to be turned over to the ship's mechanics, brought on board and put to use, forgetting the necessary routine incident to the receipt of material. In getting stores from the yard, the ship's general storekeeper should see that representatives from the departments interested accompany the working party, so that the stores may be inspected before being drawn from the storehouse.

INVENTORY OF SUPPLIES should be always in progress. In spite of every care the books will be found to need constant, if slight, adjustment. After the trial several times of a comprehensive and exact inventory of Title X, the following is recommended as most likely to be accurate, and to wear least on the storeroom force. Provide the storemen with forms for a daily inventory by

Form 4

STOREMAN'S DAILY INVENTORY OF SUPPLIES, TITLE X

U. S. S. COLORADO

Instructions:—One to be filled out by each Title X storeman and turned in to stock ledger yeoman

Name of Storeman..... Date.....

Stock No.	Article	Unit	Quantity on hand	Gain		Loss	

each of them of, say, ten items, to be chosen by themselves in the course of the day's work. This form may conveniently be as shown by Form 4, which has been successfully used. The storeman is thus relieved from facing the big job of an inventory with the monotonous counting it involves (which no one can continue long with accuracy), and in lieu is given a light daily task which he can absorb in his regular duties in the issue and care of stock. These forms when filled out, except as to the last two columns, are turned in to the stock ledger yeoman. He compares the quantity on hand with that on the ledger, enters in the ledger the date of the inventory, and makes any necessary adjustment to accord therewith, as well as adding the gain or loss involved on the inventory sheet. The sheets are then filed for use

in making up the vouchers to cover the gain or losses for the quarter. If the stock ledger yeoman suspects from his comparison with the ledger that a mistake may have been made in the count, he crosses the item from the inventory sheet and directs a recount. From time to time he goes through the ledgers and notes items which have not been inventoried for too long a period, for an early count by the storemen.

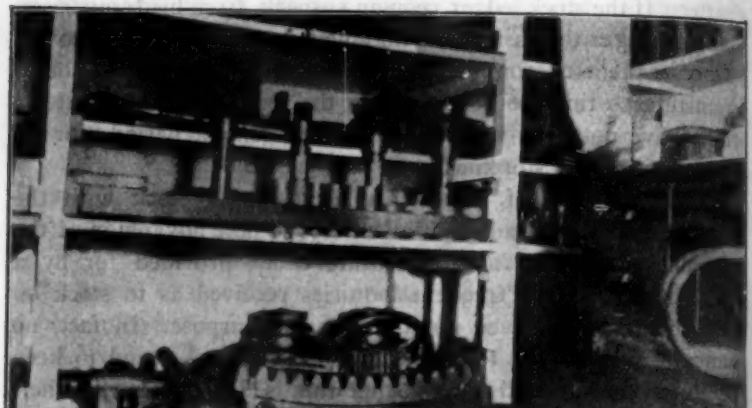
The comparison of storemen's requests for stock with the ledger should often lead to an inventory, to take advantage of the favorable conditions for an accurate count provided for by a depleted stock. The frequent inquiries received as to stock on hand should be followed up for the same purpose. In fact, no chance should be lost to compare stock and books, and to keep the storemen constantly aware that this is done, and with their pride aroused if possible to see that discrepancies are as small as practicable.

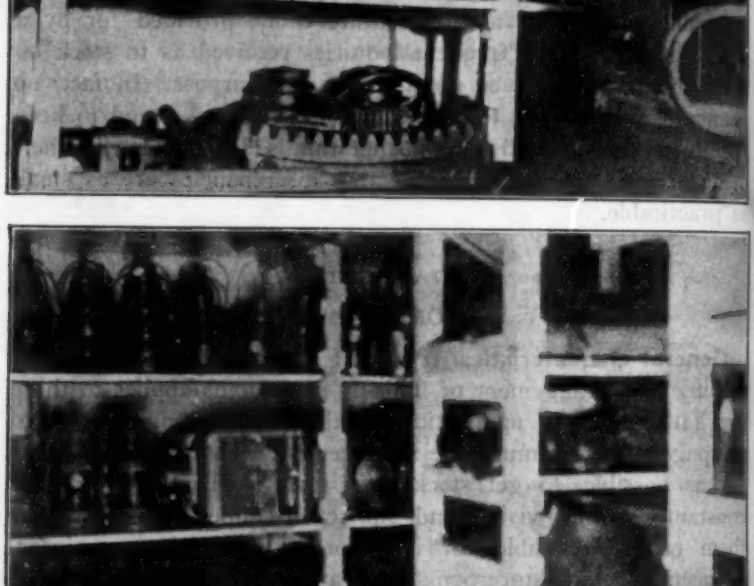
EQUIPAGE TITLE B.

STOREROOMS.

General characteristics. Most of what has been stated concerning the arrangement of Title X storerooms applies to those for Title B. The application of the storekeeping axioms to equipage produces much the same results. To concentrate it as far as possible, to get stocks "in store" where they can be constantly within vision and subject to supervision, to make them easily accessible for issue properly, requires an interconnecting set of storerooms with a gang of interested, standardized storemen, standing in regular watch. As with Title X, these storerooms, if possible, should have a common entrance to combined issue and receiving room, where those who call may wait while being served, and where items received on board, or turned in for store or survey, may be laid out until proper action be taken.

The care of surveyed material constitutes an important element in equipage storekeeping, which can be almost disregarded in Title X. Supplies in store should require survey only infrequently, while damaged or worn equipage is constantly being turned in. To provide for this, the series of storerooms for equipage must have a compartment set aside for surveyed items.





THE TITLE "B" STOREROOMS.

The upper picture shows a part of the receiving room with Storeman's desk, and shelves of Class 1; the lower picture, a corner of an adjacent compartment, showing parts of Classes 12, 13, 31, 36 and 37. This latter storeroom contains all equipage "in store" Classes 5 to 37, arranged by classes and alphabetically in each class, except 10 and 11 (stored with 60 and 61), 16 and 17 (electrical, have special compartment immediately below), 19, 20 and 22 (in hold), and 35 (in library cases).

A storeroom 12′ x 8′ x 6′, fitted with proper shelving, is none too large for this purpose. Material waiting survey has to be kept so that it may be readily examined, and separate from that already surveyed and waiting the disposition recommended. It is surprising how surveyed material collects in the ordinary routine of a ship, and it is almost invariably of a kind which is difficult to stow closely or to keep from being further damaged without adequate space for it.

Special fittings for equipage need be discussed only with reference to equipage "in store," either as spares to be issued to replace working parts as they break down, or as items subject to withdrawal and return after temporary use. Equipage in continuing or "permanent use" concerns the office rather than the storeroom part of the general storekeeper's work, as he merely keeps its accounts and has nothing to do with its custody, that being wholly the care of the ship's departments.

FITTINGS FOR MAIN STOREROOMS have to be provided for items of the most varied character. General suggestions only as to what these fittings should be can be given here, as the character and arrangement of the storerooms have much bearing in determining them. The requirements for receiving rooms as to shelving, desk and storemen's lockers given for Title X apply. A rack should be installed here to receive library books as they are turned in. About 850 linear feet of shelving is estimated as necessary for the equipage in store of a first-rate ship, but it cannot be so regular in dimensions as that provided for Title X. A certain length, say a hundred feet, will have to be extra heavy to accommodate spare engine and auxiliary parts. In the ideal storeroom enough open space would be left to care in their proper classes for bulky items like armatures the illuminating set, dynamo covers, hospital cots, mattresses, etc. A light rack to carry the bags in which they are put, is needed for flags. One 12 feet long with notched parallels, 24 inches apart is good for small spare armatures. A part of the storeroom system should be fitted for hand tools, which are used temporarily and returned to store. As there is more traffic to this part of the storeroom than any other, it should be convenient to the issue room. Shelves should be as thoroughly lighted with small lamps as with Title X.

FITTINGS FOR OUTLYING EQUIPAGE. The libraries are usually provided for outside the storeroom. The ship's library (books of

reference and serious works, to the number of about 900 volumes), is commonly kept in the officers' quarters and mostly used by them. This, together with the crew's library (also about 900 volumes, mostly fiction), should be kept in glass fronted cases, the bottom shelf raised somewhat from the deck. They should be as open as possible for inspection of the titles of the books, while being under lock and key. Many ship's bookcases now have solid doors.

Coaling gear is preferably stowed on the upper deck where it is most convenient for use and makes the minimum amount of dirt. A locker 14′ x 12′ x 6′ has been found to be sufficiently large for this. Water breakers, like abandon ship rations, must be kept in a promptly accessible place. A locker 6′ x 8′ x 6′ on the upper deck will do for this purpose. Mine gear being special and seldom used, may be given a separate storeroom without sacrifice. So also may have to be other bulky and seldom used items, such as the large armatures, illuminating set, quarter-deck awnings, tents, etc., named above.

EQUIPAGE TITLE B.

STOCK.

An understanding of the variation in stock keeping methods for equipage from those described for supplies, will be helped by detailing here the specific differences between items in Titles B and X. Equipage is subject to survey after use; supplies are not. Hence it is necessary to follow the course of equipage after issue, and generally to receive it in the store again when worn out, to arrange for its final expenditure. Equipage is carried in a fixed allowance for each ship's department under each item. Supplies allowed are carried for issue in any quantities as needed with a quarterly money allowance only for each department to govern its total expenditures during the quarter. Equipage afloat has been paid for by the appropriations supporting the various ship's departments, and is therefore carried under the cognizance and supervision of the respective heads of departments. Supplies are not paid for by the bureau appropriation until actually drawn, and are therefore more strictly under the undivided cognizance of the general storekeeper. Equipage may be either "in use," or "in store." Supplies are "in store" only.

When put to use, supplies usually lose their identity as individual items. Much equipage "in store," tools, flags, etc., is issued again and again for temporary use and return. Withdrawal for temporary use practically never happens with supplies. Supplies being in a single account, all items of the same kind can be grouped together without distinction. With equipage, where frequently similar items are carried several accounts (hammers, ball peen, for instance, in C. & R., SE., Ord. and Equip. Departments), care has to be taken to distinguish between the property of the different departments.

Concentration of equipage "in store" is most desirable. All such items possible should be collected and systematically arranged in the storerooms allotted for equipage. This arrangement should consist primarily of segregation by classes. Fortunately, the classification adopted generally permits whole classes to fall under the cognizance of one department. But where this is not so, as notably in Class 41 (hand tools), experience now indicates that items of the same kind should still be put together though the property of the different departments, being distinguished in some other way than by physical separation. Different colors can be used for the different departments, marking the individual items with paint where possible, or the shelves on which they lie with the proper distinctive color.

As with "X," there will be some forced exceptions to a strict arrangement by classes, due to special characteristics of items, or the limitations of the storeroom; but in general it will be found that such arrangement is feasable, and that where applied, all transactions with regard to the stores concerned are simplified.

STOCK NUMBERS FOR EQUIPAGE will also be found to increase the certainty of all operations relating to it. A practical system is one in which the items having been arranged on the ledgers by classes (and if necessary, as with ordnance, with classes, subdivided), and alphabetically within each class (or subdivision), each department is given its distinctive series of numbers by indicating first the initials of the department; second, the number of the class; third, the initial of the item, and last, the serial number of the item under that class and initial. The final number need not indicate the exact position of the item in the ledger, inasmuch as the character of references made to the books makes it desirable to have the alphabetical arrangement govern. This situation

differs from that under Title "X." Nine-tenths of the use of stock ledgers for supplies is in posting expenditures already identified by stock numbers. In this case time and labor are saved in finding ledger pages, by keeping the number sequence unbroken. With equipage, present experience teaches that in most of the inquiries or transactions affecting the ledger, the name of the item features more prominently than its stock number. Hence with B the alphabetical order should control. In either case, one or the other sequence should be absolutely adhered to, or confusion will result.

The most desirable condition is to have both systems, letters and numbers, constantly run together. This is possible with equipage, as comparatively few new items are received after the ship's outfit has once been supplied. When new articles come, therefore, it is well to make the few changes in stock numbers usually required, to conform with the strict alphabetical arrangement, and keep stock and ledgers completely and consecutively indexed either way. With X the strict consecutive series of stock numbers has to be broken temporarily now and then by "dash numbers" as later described.

Illustrations of the stock number system for equipage follow. Ordnance galvanized iron buckets being the first item under B in Class 12, in ordnance, has the number O12B1. The same kind of bucket in steam engineering, being preceded in the B's of Class 12 by Boards, bulletin (key, muster, station), and buckets (ash and coal), are SE12B7. ESA28D2 represents doilies, wardroom, Class 28, department, Equipment S. & A. Similarly O41S10 indicates ordnance screw-drivers, Class 41.

These stock numbers are indicated while "in store," by circular metal rimmed tags attached to the items concerned. Usually the particular sample bearing the tags can be left in stock. Where, however, it is necessary to issue for temporary use, the tag is removed, and hung on the shelf until the item is returned. If the item is withdrawn for permanent use, the tag should be saved by the storeman until further supplies are received. The possibility of the temporary separation of the tag from the item makes it desirable to add to the information carried by the tag the name of the item, as well as the stock number and the low limit, as with Title X. The entry of the unit of issue, so essential on the

Title X stock tags, is not usually necessary with those for Title B.

In the cases of Ordnance and Equipment-Steam Engineering, it has been found convenient to subdivide the largest classes before starting the alphabetical arrangement. All parts of all guns, for instance, are under Class 1. These are so numerous, and the unofficial nomenclature for them so varying, that results are much more certain if the items are subdivided by calibers and under the main elements of the gun to which they pertain. The index to the ordnance ledger of an armored cruiser, Form 6, shows the divisions into which her Class 1 naturally falls.

FORM 6.

SYNOPSIS OF ARRANGEMENT OF ORDNANCE LEDGER.

U. S. S. COLORADO.

Stock ledger sheets are arranged by classes consecutively and in alphabetical order in each class or division under each class.

Stock Numbers. From	To	CLASS 1. Items are grouped as follows:
		8-INCH.
01A81	.....	Guns, complete.
01B81	01B819	Carriage, complete and spares.
01C81	01C84	Slide, complete and spares.
01D81	.....	Stand, complete.
01E81	01E814	Breech Mechanism, complete and spares.
01F81	01F810	Sights, complete and spares.
01G81	01G846	Firing Locks, complete and spares.
01H81	.....	Attachments, elec. firing, complete.
01J81	.....	Attachments, night sight lighting, complete.
01K81	01K82	Gas Ejectors, complete and spares.
01L81	01186	Miscellaneous.
01X81	01X811	Ex-Caliber, complete and spares.
		6-INCH.
01A61	01A62	Guns, complete.
01B61	01B644	Carriage, complete and spares.

(A similar arrangement to the 8-inch for this and all other calibers.)

CLASS 2. Items are grouped as follows:

		8-INCH.
02A81	.....	Guns, special equipment for.
02B81	02B814	Carriage, special equipment for.
02C81	02C85	Stands, special equipment for.

(Similarly for remainder of items of this caliber and all others.)

CLASS 3. Items are grouped as follows:

		AIR COMPRESSORS.
03P1	03P23	Complete, and spares.

(Etc.)

CLASSES 11 to 65. Arranged in strict alphabetical order, using the initial letter of each item in the stock number in place of the arbitrary letter used after Class Nos. 1, 2 and 3.

In cases like this, the system of stock numbers must be varied slightly, assigning arbitrary symbols throughout the class to these various elements, indicating the caliber or character of the gun. To refer to the typical index given, the letter B is assigned to anything which pertains to a carriage, the letter E to anything relating to a breech mechanism. The figure or letters following this symbol denote the caliber concerned. Thus, O1B86 indicates ordnance Class 1, carriage eight inch, balls, one inch diameter, variable speed gear, spare. O1E810, indicates springs, tray, latch, catch, spare, in ordnance Class 1, eight inch breech mechanism. It must be remembered that the final number has no significance except to distinguish it from the other items in the category described by the letters or numerals preceding, though an effort is made to have it indicate the proper alphabetical letter of the item in that category. Similarly, O1B3FG1, indicates bar, trail and coupling for the three inch field gun carriage. This system, though apparently intricate, is in reality quite simple, and solves the problem presented by the great number of different items in the ordnance classes, and the various usages with regard to their nomenclature.

An objection to the system of stock numbering for equipage outlined is seen in the example given of galvanized buckets. The same item may have several different numbers. Hammers, ball peen, lying on the same shelf, would have four different numbers. This cannot be helped under the present system, though it indicates a defect which must sooner or later be cured, *i. e.*, the carrying of items suitable for general use under any but a general account. This situation might be solved either by transferring such items to Title X, with provision for their being loaned out until lost or worn out when their cost could be prorated and charged by survey to the proper appropriation; or by carrying them under the sole cognizance of one appropriation for the use of all departments, as was done with items of Title X type allowances for torpedo craft.

Accessibility of equipage "in store" is also of prime importance. Many items are needed in haste. They should be instantly producible in good condition. Arrangement so far as possible in classes, and alphabetically in each class, conduces to this. Pasters should be put on the edge of the shelves explicitly indicating the department concerned, and, if the alpha-

betical order is broken, where the missing items in the class may be found. A man always on watch, and the storeroom always open, induces the confidence of the departments. This is more important with B than with X. With the former, the head of department may exercise his judgment as to what may be left in store, and withdraw and put into permanent use. If he has confidence in the accessibility and care given his gear, he will be inclined to turn in all possible. This is the ideal condition, as the fewer items there are out about the ship which are not in actual continual use the better.

The question of reserve stock does not arise with the same insistance as in Title "X." With few exceptions, either all or none of the spares in any item of equipage can find place in the storeroom. Ditty-boxes, however, form such an exception. There must be a few of these ready to issue, but it is scarcely to be hoped the full stock of spares can be carried in the main storeroom. A list of all items "in store," but not in the main storeroom, with their stock numbers and location should be kept on the storeman's desk to help the ready finding of any item not in its proper order. This will serve for all cases of stock not concentrated, and will supplement the directions on the shelves.

The ship's library may be made easily accessible without loss in accountability, by the use of the wardroom wine-mess boy as its custodian. This boy is usually selected on account of his intelligence, and is accustomed not only to keep things under lock and key, but also to get chits for what he issues. After the books have been arranged and the catalog posted, give the wine boy the keys to the book cases and charge him to be as particular to get chits for books as he is for cigars, and to try to collect the books on the first and fifteenth of each month, and an effective solution will be found to the question of the handling of the ship's library.

Maintenance of title B stock is the one part of work with equipage which is simpler than Title X. The renewal of equipage ought to take place almost automatically, if the allowance lists are kept corrected to current conditions. The object of the general storekeeper is to maintain in good condition on board the allowed number of each item, in spite of casualties. When this number is increased by transfer or by loss, requisition is made to complete the outfit once more. Many items of spares allowed in quantities greater than necessary to meet any ordinary

depletion, such as tools, crew's mess gear, ditty-boxes, etc., may be allowed to run down to a pre-determined low limit before completing the allowance. This saves a needless multiplicity of requisitions. On such items a low limit is established after consultation with the head of department, and entered on the stock tag and ledger sheets in the same way as with X (see Form 7). Ordinarily, however, no such watchfulness as with

Form 7

MEMORANDUM OF TITLE "B" ARTICLES TURNED INTO STORE FROM "PERMANENT USE"

U. S. S. COLORADO .....191..

Instructions:—To be filled out by storeman on watch and sent to office of general storekeeper when any item is turned in which has been out in "permanent use."

Stock No.	Amt.	ARTICLE	Dept.	Turned in by	Date turned in	Condition of article	Initials of storeman

X is required by the storeman in keeping up stock. All they have to do is to make sure chits are received to cover all movement of stock, and that these chits are put in the proper course.

It may be noted here that the allowance lists of equipage of many ships are in great need of revision under some co-ordinating influence. For example, at the present time, each of several bureaus has allowed its ship's department enough tools of a certain kind for the entire ship. Thus money is uselessly invested, and the ship forced to carry much needless gear. An illustrative case is that of monkey wrenches. The allowance lists of the *Colorado* call for the maintenance on board of the following:

24"	Wrenches	allowed	2,	of which	2	are	usually	in	use.
21"	"	"	19,	"	"	2	"	"	"	"
18"	"	"	30,	"	"	8	"	"	"	"
15"	"	"	29,	"	"	8	"	"	"	"
14"	"	"	2,	"	"	7	"	"	"	"
12"	"	"	52,	"	"	27	"	"	"	"
10"	"	"	42,	"	"	21	"	"	"	"
8"	"	"	43	"	"	26	"	"	"	"
6"	"	"	30	"	"	14	"	"	"	"

This is not by any means the only instance of apparently excessive allowance, nor should mention be omitted of the good work

a revision of allowances could do in pruning out altogether much that is obsolete, or unnecessary, from the present lists.

Custody of equipage is somewhat more difficult than of supplies. Items of equipage tend to be more varied, complex, and delicate. The use of tools, the rudiments of electricity, a superficial knowledge at least of ordnance material, in general a quick perception of mechanical relations, is necessary in the head Title B storeman. A man with these requirements is not so hard to secure aboard ship, as many with mechanical turn of mind select the service particularly in the engineer's force. The best storeman available is not misplaced when put in charge of Title B.

There are many methods in the care of stores yet to be generally learned. They may be largely inspired by the constant sight of stock on the shelves illuminated as described for Title X. In case of any question as to the condition of equipage in store, the expert advice of the technical departments should be sought. In many cases it is well to invite representatives of these departments occasionally to go over their stock with a view to offering suggestions as to its care. Amongst the precautions for equipage, the following may be mentioned as a far from complete schedule. Very small parts in ordnance should be put in manila envelopes ($3\frac{1}{2}'' \times 5''$, open end), with the stock numbers, name of item, and, if necessary, the low limit written on the outside. Many of these parts are too fine and small to take a stock tag and are less likely to get lost or deteriorate when thus carried. Slightly larger items can be arranged and safely kept in open cigar boxes neatly painted. A plentiful supply of these can always be obtained from the canteen or the wine-mess. Flags should be kept in camphor in paper bags, the bags being stenciled on one end with stock number and name. Fabric items of battalion gear, athletic outfits, etc., should be camphored. Rain clothes should be done up in neat bundles packed loosely, and occasionally moved to guard against combustion. Case-hardened steel should be kept with a film of oil over it. Bright steel should either be kept bright with a coat of oil, or in case of large parts not likely to be used for a long time and needing protection from scoring, like piston rods or valve stems, be heavily painted or covered with white lead and tallow and sewed up in canvas. Brass and nickel should be kept bright.

Boxes of spares should be kept filled sedulously. Whenever an issue is made from such a box, the rule should be to take immediate action to replace. Ordinarily the broken item which causes the issue is turned in. The exchange thus effected of a good for a worn item will in itself start a survey. The worn one becomes "spare," and is surveyed as such. If the article replaced is not turned in, the chit marked as "missing" should be sent to the office for a survey. Sometimes it is possible to replace an item in a box of spares from X stock. In this case the head Title B storeman should secure a chit from the proper head of department in the usual way.

Accurate accounting for equipage is accomplished as follows:

ISSUES OF TITLE B from store under any of the various appropriations are naturally divisible into three classes. A glance at a Title B chit (see Form 8) will show it provides for items issued:

1 For temporary use and return to the storeroom.

2 To replace items (turned in / missing) for survey.

3 For permanent use and charge on custody record of.....

Form 8

TITLE B, "COLORADO," BUREAU.....

Issue to .....Date.....1912

Storeman's entry	No.	Do not erase or enterline, write plainly, one item only on each line. Full description of article.

NOTE: Indicate below whether required:

(a) For temporary use and return to storeroom

(b) To replace item turned in / missing for survey

(c) For permanent use and charge to custody record of: .....

Person authorized to sign chit

.....

Issues for temporary use are the most frequent. These are of tools for the most part, but may be of any sort of item, lamps, books, rain clothes, athletic gear, dotters, portable lights. The list might continue almost indefinitely. The storeman examines

the chit in such a case to see that it is properly complete, and particularly whether it is held by the person indicated to receive the item (or a proper messenger from him), and is signed by one authorized to validate chits. The storeman then makes the issue, enters the stock number on the chit, secures the receipt of the person actually receiving on its face, if other than he to whom issue is ordered, and files it alphabetically under the name of the latter, with other "temporary use" chits. On return of the item the storeman surrenders the chit and the transaction is complete,

Form 9

U. S. S. COLORADO

Job order request No..... .....191..

From: GENERAL STOREKEEPER.
To : COMMANDING OFFICER

Subject:—Requesting issue of ship's job order for work within capacity of ship's force.

1. I request you direct that necessary repairs be made to items "in store" indicated below:

Dept.	No.	Item	Recommended by

Paymaster, U. S. Navy,
General Storekeeper.

Approved and forwarded to Head of.....Department, who will see that necessary repairs are made to place above items in proper condition for issue or transfer.
Return with report when completed.

Captain, U. S. Navy,
Commanding.

Items drawn on "temporary use" receipt, work completed and items returned to store.....191..

.....U. S. Navy,
Head of Department.

no book work being required. If the item is returned in poor condition as to cleanliness, etc., the storeman may refuse to receive it until it has been put in proper shape. If it is damaged he receives, tags it with the name of the person turning it in, and immediately reports the item to the office for survey. Articles needing repair within the capacity of the ship's force, as recommended either by survey or on independent investigation of the storekeeper (see Form 9), are withdrawn by the department making the repairs, on a temporary use chit. At present the supplies required in these repairs are drawn by the departments under their money allotments for current maintenance, though strictly speak-

ing their value should be recorded separately as a charge under Title P, and the allotments relieved from these expenditures.

Repairs to equipage beyond the capacity of the ship's force, when recommended by survey, are made by the yard, and the cost reported under Title P by them. In such cases the items are sent to the yard shop on a memorandum receipt, and when repaired are returned without the formality of a double transfer. This procedure is convenient, but it involves the exercise of care that all such items are returned before the ship leaves the yard.

Library books, (ship's and crew's) and ditty-boxes require special forms of issue for temporary use. A method for facilitating the use of the ship's library has been referred to. The crew's library requires the formulation of a set of regulations both for the persons drawing books, and for the storeman issuing them, depending upon the facilities and ideas of administration of the ship concerned. Asset of such rules which has been found to work well is shown below as Form 10. It is very convenient,

FORM 10.

U. S. S. COLORADO.

ORDERS FOR CREW'S LIBRARY.

FOR PERSONS DRAWING BOOKS.

Books may be drawn at *1 p. m. Wednesdays,* and *9 a. m. Sundays.*

All books must be returned to the Title "B" storeroom (opposite sickbay) where they will be received by the storeman on watch at any time. Books will not be received for return at the library. No book shall be kept out more than *15 days.* On return, receipts for books should invariably be obtained from storeman and destroyed. *Otherwise report that the book is overdue may be made to the executive officer.*

No book will be received on return in damaged condition unless the word "worn" is entered on the receipt at the time of issue, to show its poor condition.

A numbered catalog of the library will be kept on the "LIBRARY BULLETIN BOARD." All persons must choose the book desired, noting number, before the time of issue, as, to expedite the issues, no examination of books will be permitted at that time.

FOR STOREMAN.

Books will be numerically arranged and kept that way. Before the issue hour, all books returned must be taken to the library and put into proper places. During the issues no one will be allowed in the library compartment except the storeman. There must always be present two men to make issues: one man to fill out receipts, and one to get books from the shelves.

If but one of his storemen is available for this work, the Title B storeman in charge will apply to the pay office for assignment of another man.

After issue, all receipts will be taken to Title B storeroom and filed by number. On the 1st and 15th of each month report shall be made to the G. S. K. office of all books outstanding more than *15 days* and names of persons drawing them.

Be sure to deliver receipt therefor to every person returning a book.

Paymaster, U. S. Navy,
General Storekeeper.

for instance to provide that books of this library may be returned in to the Title B storeroom at any time. The books come back more quickly and are saved being knocked about the decks after the person drawing them has lost interest in them. It is also a good plan to prohibit the turning in of books during the hours of issue. This simplifies the work and reduces confusion of the latter process. Often a hundred men will be in line to draw volumes. Ordinarily, two storeman should attend to the issue, one to get the books from the shelves, the other to prepare the receipts. These receipts are kept in the Title B storeroom to be returned as the books are turned in.

The simplest method for keeping track of and recording issues from the crew's library is by the use of an unbroken series of numbers which are assigned to the books whenever rearranged and catalogued, and pasted on the back of each volume. It is preferable when this arrangement is made to put the books in alphabetical order, either by title or author, so that the numerical sequence may run with the alphabet. But the number should control, and accessions to the library must be added on the last shelf to the number series, regardless of the name. With the catalog showing the number of each volume, all business can be done by it; the book being called for, found on the shelves, and turned in by the use of the number only. A bulletin board is found to be the best means for posting the library catalog. Any list not protected by glass soon becomes defaced or misplaced. The bulletin board is also convenient for the posting of library notices, such as the regulations governing it, list of new books received, interesting books at the moment, like those on the country the ship may be visiting, etc. Form 11 shows a convenient style of chit for crew's library books.

Form 11

_____ I acknowledge to have rec'd the crews library book below
Book No. described. (Sig.).....
(Write your name plainly.)

Date..... Rate.....

RECEIPT FOR LIBRARY BOOK, TEMPORARY USE, TITLE B.

"U. S. S. COLORADO"

Name of book.....

Author.....

Ditty-boxes, although, strictly speaking, equipage in permanent use, can be handled more conveniently with temporary use chits. Many men have ditty-boxes who are responsible for nothing else. The custody record is thus saved the addition of many names which would otherwise appear in it. It will be noted that the form of chit submitted as Form 12 requires the man's receipt.

Form 12

DITTY BOX RECEIPT .....
Name

Temporary Use—Title B

U. S. S. COLORADO .....
Date

I acknowledge to have received one government ditty box; to be kept in as good condition as possible, and turned in before leaving ship.

.....
Signature—write as plainly as possible

Distinguishing Marks on Box .....
Rate

..... Lieut. Comdr., U. S. N.,
Executive Officer.

This addition, not found in the other forms of temporary use chits, is made merely with the view of further impressing upon the ordinary type of man his responsibility for the care of his ditty-box. It means more to such a one to have "signed for" a box. These chits may be either kept in the storeroom or in the office, depending on the personnel in each, so that when a man is transferred, or turns in his box, there shall be the least chance of overlooking the receipt.

Ditty-boxes should be identified by a consecutive series of numbers in the same way is library books. No government box should be permitted to remain in use without an identifying number, and no box should be issued without one. The number of all boxes should be marked on the receipt. Thus when any get adrift, or into the lucky bag, they can be easily identified.

The head storeman in Title "B" should be instructed to go over the temporary use chits in his file at least once a week and report to the office any cases in which items have been out over a month. This will lead to discovery of cases of loss which have not been reported, and keep the temporary use list in a healthy condition. It will frequently be found that items drawn for temporary use have passed into permanent use, in which case they should be put in the latter category and placed on the custody record as later described.

Issues of spares to replace loss or damage to equipage already in use constitutes the next most numerous class of issues. Ordinarily the broken or worn article is brought to the storeroom with the chit to cover its exchange for a new one. A chit is necessary to make sure that the head of department or authorized person signing it has knowledge of the damage. The chit is taken up by the storeman when he makes the issue. He enters the stock number on it for further identification, tags the broken item with stock number and name, and puts it in the survey section of the storeroom. He then sends the chit to the office to start the survey.

There are two variants to this procedure. Sometimes the nature of the case is such the new item must be drawn before the old one can be taken from place and delivered. In this case the storeman makes the issue, takes the chit and holds it on his desk for special attention until the transaction is completed by delivery of the old item. Sometimes the old item has been lost, or has otherwise disappeared in the casualty requiring the issue. In this case the storeman makes the issue, makes sure that the word "MISSING" is properly indicated on the chit, and sends it to the office for the special character of survey required. No case involving the simple replacing of equipage affects the custody record for, obviously in all such cases, the number in the custodians possession remains the same.

Issues for permanent use constitute the third class of issues of equipage, and while the least numerous involve the most clerical work. The storeman is instructed with such issues, to be sure that beside the data usually required on other chits, there is also entered the name of the person into whose custody the item is to pass. The chit is then sent to the office at once for preparation of the custody record, and is carefully retained until the record is signed. Storeman should be directed to accept any items in per-

manent use turned in, whether with or without accompanying authority; but when such items are received, they should make report at once to the office. Form 7 previously printed, is a useful one for this purpose.

Except in case of emergency, there should be no issues in B without receipts, there being no circumstances except emergency making such necessary or advisable.

RECEIPTS IN TITLE B are treated much as in Title X. They are laid out on the receiving floor until identified with the item and requisition under which drawn, given a stock number, and inspected by a representative of the department concerned. That this last should be carefully done is particularly important. The head of department depends on the outfit provided for his department to be on board, and of proper type. His inspection of all newly arrived equipage, either in person or by competent proxy, should be insisted on by the storekeeper. Only in this way may the latter be assured that items suitable to the department have been supplied. Now and then, articles of old type or character, not suited to the particular vessel, will be sent from the yards in spite of all care by the yard storekeeper. As in the similar inspection under X the storeman secures the written O. K. of the person inspecting upon the delivery slip or shipping memorandum. The inspector's initials should be noted also on the Record of Requisitions for ready reference, in case of future question.

SURVEY EQUIPAGE is constantly collected as a result of casualties, natural and otherwise. As indicated, part of the available storeroom space should be specifically set aside for it. Damaged stock should never be mixed with the good. Articles awaiting survey and those surveyed and held to turn in, either to supply ship or storehouse, should be kept separate. If pending this opportunity, use can be made of surveyed items, they may be drawn on temporary use chit marked "surveyed" in large letters across the face. The item can then be easily found to call in when required.

The regulations permit summary disposal of condemned articles of negligible value, or whose usefulness is wholly destroyed, by burning or throwing overboard. This practice not only results in economy in office work and transportation, but gives great relief from the conditions of former practice which required all condemned items, no matter how worthless, to be kept and turned

in. Items of value which ought to be turned in accumulate rapidly enough in the ordinary wear and tear of a city of machinery. As they collect, they should be tagged immediately with name of ship, department concerned and stock number. When surveyed they should be packed at once for transfer at the first opportunity, but the box or package in which placed should not be finally secured until its contents have been checked by one of the office force, and each tag marked with the item invoice number. Finally a copy of the invoice of the contents should be placed in the box. The differences which frequently arise over invoices and the contents of shipments containing surveyed material, after their arrival at the yard, make it very desirable for the ship to be sure of its check. To do this it is well to have two men present when the contents are finally verified and the box sealed. The outside of the box should have plainly marked on it, besides the forwarding address, the name of the ship, bureau, and invoice number. Items of more than one bureau should not be packed together unless necessary. There is a particular reason for insisting that care be taken with such shipments. The worn and broken character of the items makes identification more difficult, and frequently they are sent to a yard at a distance, via a supply ship or collier, which makes it hard to adjust misunderstandings and differences in count. Because of its character, it is also found that storemen are inclined to treat survey equipage carelessly, and that unless an effort is made to anticipate the rush which seems to be normally incident to the transfer of stores, it will be dumped into store in a condition not creditable to the ship. The way in which surveyed gear is turned in is one of the best tests of efficiency of a ship's storeroom force.

INVENTORIES OF EQUIPAGE should be kept running. These are complex, as items in use have to be considered as well as those in store. Blanks (Form 13) should be supplied the storemen for the entry of the quantity in store. Items under one Bureau are chosen by him up to a designated number each day, and the quantity in store counted. The forms complete as to stock number, unit of quantity, and quantity in store, are then sent to the office. There, the correct name of item, balance on ledger, quantity in use, and custody record are entered. They are then forwarded to the department concerned, which checks up the quantity in use, whether permanent or temporary, and returns the forms to the general stor-

keeper's office for comparison with the stock ledger. Thus is put into operation a method which avoids the monotony and consequent errors of a continuous consecutive inventory. Whenever desired these forms may originate in the general storekeeper's office for items in doubt, or not recently inventoried.

Form 13

Daily Inventory of

TITLE "B" AND CUSTODY RECORD

U. S. S. COLORADO Date* Bu.*

(Storeman fills out all spaces marked *)

Item.....

.....

Unit of Quan.*..... Balance on ledger.....

In store*..... In use..... Total.....

Gain or Loss .....

CUSTODY RECORD

No.	Name	Rate	Location

Stock No.*

It may be considered more to the satisfaction of the other departments to conduct the inventory of equipage in use by *persons* rather than by *items* as here described. In this case the storeman's inventory of the quantity in store is made as indicated, and the upper half of the sheet completed at the office, the quantity shown on the books as in use being assumed to be correct. This assumption is not justified by experience so far, which is, that differences between the ledgers and the quantity actually on hand are, if anything, more likely to appear in the portion of the item in use than in that in store. This is due to the fact that breakages and loss are constantly occurring which are not reported to the general storekeeper's office, by any of the various agencies from which such information should come, such as the head of department, officer-of-the-deck, officer of engine-room watch, or the man concerned. Frequently not one of these persons knows of a loss until the checking up incident to the inventory takes place. Often again the custodian alone knows of it, and fails to report. However, that may be, the loss of equipage in use eventually comes to light

if copies of all the custody sheets of each person in turn on the custody record are methodically forwarded to the heads of departments to be verified in that way. Undoubtedly, this method would be easier for the general storekeeper's office and the Department, than to take the inventory by *item*, where perhaps one daily inventory sheet would involve several persons; but its value as a count would not be so great. I, therefore, prefer the plan first outlined.

Special equipage inventories are those of the libraries and of officers' mess gear. With the system of numbering books described the former is simple. Either the book or a numbered chit should represent every number in the catalog. The count of officers' mess gear at the end of the quarter should be made by a yeoman on arrangement with the mess treasurer concerned whose presence would be secured at the inventory if possible. If desired, a muster at sea of ditty boxes can easily be accomplished.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE UNITED STATES SHIP *IDAHO*.

REMINISCENCES, 1866-1870.

By REAR-ADMIRAL O. W. FARENHOLT, U. S. Navy.

Few ships of our navy have had a more eventful, if short, career than the first *Idaho*. She was about one-third of the tonnage of her namesake, the present battleship *Idaho*, yet when afloat, and for many years after she was broken up, she was, and had been, the largest sailing vessel of all maritime nations.

During the last two years of the Civil War, we laid down and built twelve large commerce destroyers, and but few of them had been launched with the war was ended, and four of these vessels were broken up on the launching ways many years afterwards. These ships were to have been the largest (from four to five thousand tons burden), the swiftest, and most powerful armed vessels afloat. All were built of unseasoned wood—no other was obtainable—and ten years later, not one of them was in active service. They were called the *Wampanoag* class, and had quaint Indian names. I remember the *Wampanoag, Passaconaway, Memphramagog, Piscataqua, Katahdin, Pushmataha,* and others.

The *Idaho* belonged to this class, although totally different in many respects. She was built in New York on the lines of the yacht *America,* by the celebrated naval architect George Sears, the builder of that yacht, in 1851. Her (the *Idaho's*) engines were designed and built by a Mr. Dickerson. They were a new type, and the contract with the government required that the ship should steam fourteen knots per hour, an unheard of speed for steamers in those days. Under the most favorable conditions, she never made more than ten knots per hour, and Mr. Gideon Welles, our Naval War Secretary, ordered the engines and boilers removed, the former to be broken up, and the latter to be placed in another steamer. The *Idaho* was then rigged as a three-masted sailing ship, and was

to be stationed as a store and hospital ship at Nagasaki, Japan. Immediately after the Civil War we had sent ten fine modern warships to the Asiatic Station, which at that time embraced the waters and coasts from Cape Town in South Africa, to India, Australia, China and Japan.

The changes and alterations in the ship were made at the navy yard in New York. The large "built up" lower masts were allowed to remain in their original places; the ship was heavily and loftily sparred to royals. Her main yard was one hundred and nine feet long. She carried enormous single topsails, and there were thirty-six whole cloths of canvas in her lower square studding sail.

The lower hold, where previously the engines, boilers and coal-bunkers had been, was given up to the carrying of coal and stores. Half of the "between decks" was set aside as a fleet hospital, with fifty iron bed-steads to be installed upon arrival in Japan. During the outbound voyage this deck was filled with various naval supplies, in fact every foot of space was utilized to carry stores to the Asiatic station.

The original cabin, wardroom and steerage on this deck were retained, and were to be used by sick and invalided officers of the fleet. Officers, ordered to the Brazil squadron as passengers, lived temporarily in these quarters, and the midshipmen in the steerage. A small deckhouse, with very limited quarters for the captain and wardroom officers of the ship, was built on the spardeck abaft the mizzen mast. The space on the spardeck, from the straight stem to the foremast was covered with a light deck, thus making a large, comfortable top-gallant forecastle, which housed the entire crew and ships galley.

As a full rigged sailing ship, the Idaho carried a battery of eight 32-pounder smooth bore guns, two 60-pounder parrot rifles, and a crew of ninety-one men. The latter were totally inadequate to handle the ship in a man-of-war style. As a steam frigate with a full battery, her complement had been four hundred men. Our ship had a full list of officers, including eight midshipmen who were especially sent on board to learn seamanship. The present Rear-Admiral C. T. Hutchins, retired, was one of them, and Pay Director G. A. Lyon, retired, and I, are the only officers living of the thirty-two (including the officer passengers) who sailed from New York to Japan in the *Idaho* forty-six years ago.

While the ship was fitting out, many predictions were made that she would never reach her destination. These prophesies were based on the claims that "the ship was too large for a sailing vessel and could not be handled as such; that her masts were improperly stepped; that the crew was insufficient," etc. The latter statement was true, yet we managed very well, "merchant ship fashion." In light winds the ship was "sluggish in stays," and had to be carefully watched. Her foremast should have been stepped further forward.

Strange, as it appeared to us, the naval constructor, kind, genial Mr. Delano, who made all the changes and alterations, giving us those towering topmasts and unusually heavy spars, that caused some qualms until we got used to them, was himself dubious regarding our prospects at sea. Before leaving New York, Mr. Faxon, the Assistant Secretary of the Navy, came on board to inspect the ship; wished us good luck, and hoped we would arrive safely at our destination, of which he seemed somewhat in doubt.

In September, 1867, I was ordered to the *Idaho* as her second watch officer. I frankly admit I was awed when I first stepped on board and saw her enormous spardeck of 375 feet and her lofty masts; but we were all young and ambitious, were proud of the ship, and at sea soon got used to her, for she "handled and worked" like the yacht upon whose lines she was built. At that date, she was the largest sailing vessel (4200 tons displacement) afloat. I have never seen a more handsome or graceful one. Her plans and lines were copied and reproduced on a smaller scale by many maritime nations. In whatever port we lay, our vessel was the principal attraction, not only among the naval and merchant marine, but also to the people on shore.

Leaving New York on the first of November, we soon found that the ship was very swift and carried sail "like a church." During the thirty-four days to Rio de Janeiro, a more than average good passage, we did not have a "reef topsail breeze," and, consequently, could not tell what the ship was capable of with regard to speed.

One afternoon, as we lay becalmed near the equator, in company with several other sailing vessels, the fire alarm was sounded. Seeing the heavy columns of black smoke rolling up from the after hatches, we knew it was not a drill, but the "real thing." I know of nothing more startling or "heart twisting," if I so may

call it, as the cry of fire at sea; the sailor understands its awful danger, but the landsman believes, that with all the water around him nothing is easier than to put out such a fire. I have witnessed three serious fires on board our man-of-war, in one case the coal-bunkers were burning, and for many weary hours, we did not know whether or not the fire had charred a hole through the wooden hull.

The cause of this fire was the breaking of the gunner's lantern in his storeroom, and the consequent firing of the very inflammable articles stored there. The man tried to put it out alone, was nearly suffocated, and it was not until we saw the smoke on deck, that we were aware of the accident. The gunner's storeroom had been built over the after magazine. In the latter was stored more than thirteen tons of powder, which we were carrying to the Asiatic fleet. In those days, in wooden ships, the powder magazines were built on the "keelson." They were constructed of 3-inch pine planks, and lined on the inside with one-quarter of an inch of sheet lead, tightly soldered. As soon as we ascertained where the fire was located, the magazine was promptly flooded—at least we believed so—and felt easier in mind. After a hard fight we extinguished the fire, and found that the deck, and the pine planks of the magazine were badly charred, exposing the lead lining.

I have often noticed, that in the most dangerous and trying experiences, some quaint and ludicrous incident is likely to happen, which one can laugh over when the danger is passed. Our close call of the *Idaho* was no exception. When after an anxious night watch, the order was given to let the water out of the magazine into the bilges of the ship; we noticed, when we entered the magazine, that there never had been more than two inches of water in it at any time. On examination, it was found that the canvas hose attached to the flood-cock had been tightly stopped up instead of being led along the floor for the free admission of the water, and that the few inches of water had merely oozed through the canvas from the outside pressure. No blame for this gross neglect could be laid to the officers of the ship. The magazines, and even its passages, had been filled with full powder tanks by the ordnance department at the navy yard. It had been reported in perfect condition, and was not to be opened until we arrived on the station. The magazine for the ship's battery was in the forward part of the vessel.

Our senior medical officer, a genial, kind shipmate, ready to enjoy a joke at his own expense, got badly rattled during the fire. He took two 20 pound pieces of pork, which had been issued to the ship's cook for the next day "pork and bean" ration for the crew, lashed them around his ample waist, climbed onto the bowsprit, calmly awaiting for the after part of the ship to blow up and hoping, as he expressed it, "the pork would keep him afloat until he was picked up by one of the becalmed vessels near by!"

While in the equatorial latitudes, the captain permitted a boat to be lowered, so that one of our messmates, who was an excellent artist with pen and ink, could sketch the ship. I was a member of that boat's crew. There we saw a huge black vessel on a smooth, green sea, her fine, symmetrical lines, more like a yacht than a war or merchant ship; her broad white-painted stripes increasing her length to the eye, and, on her lofty spars, every sail, including the starboard studding sail, set; to me it was an impressive, beautiful sight. How I wish that kodaks had been invented at that time. Our artist made an excellent picture which was photographed on arrival at Nagasaki, and I treasure a faded copy.

We remained at Rio de Janeiro one month, and met in port our Brazil squadron. Our officer-passengers left us, and sorry we were to part with them; on the trip from New York they entertained us with many laughable, theatrical stunts.

From Rio to Cape Town, South Africa, we made the run in nineteen days, a record never excelled by a sailing vessel. The regular mail steamers schedule was from twenty to twenty-four days. We went south as far as the Island of Tristan de Acuna, experienced very heavy weather which tried the ship severely, disproved the doleful predictions made in New York, and showed to us for the first time how fast she could travel. We did not spare her; the watch officers vied with each other in carrying sail to the last moment of safety.

Leaving Cape Town after a short stay, we set a course for "North West Cape," on the Australian Continent, and made the passage in the remarkably fast time of twenty-one days. We encountered rough rainy weather and heavy seas, but generally strong, fair winds. The largest day's run was four hundred and ten miles. The log line (no taffrail log on board) broke during a squall, when nineteen knots had run out.

In gales, or light winds, no vessel ever passed the *Idaho*. A sail

would be reported by the lookout on the foretopsail yard, and if going in our direction, usually in four to six hours she would be abeam and soon far astern. We purposely would steer very near them and enjoyed their astonishment and admiration shown in cheering us. Frequently we carried topgallant sails, and passed large, strong ships under single or double-reef topsails.

We were surprised to meet so many sailing ships in the Indian Ocean, the majority bound to the eastward and flying the English flag. During our entire voyage to Japan, I do not believe we met two dozen ships displaying the stars and stripes. Even in the latter sixties, two thirds of the world's merchandise at sea was carried in sailing vessels. In many ports in the Far East steamers were a curiosity.

One day we hove to (to make repairs to a sprung yard) under the lee of Saint Paul, a lonely and uninhabited island equidistant from Africa and Australia. A boat's crew was sent on shore to fish in the sunken crater, and also to shoot (for the crews messes) wild pigs and goats left on the island by whaleships who still visited the place at intervals.

Our fair sailing ended upon sighting the Australian Continent. Calms, light head winds, strong westerly currents, were our lot for almost two hot and dreary months. For twenty days we did not make fifty miles on an easterly course. It would have been more advantageous to turn back and go south as was originally intended, through "Bass Strait" around Australia, which would have assured to us a fair and strong wind to the equator at that season of the year.

The north-east monsoons prevented our taking the short route by the way of the China Sea, and in company with many sailing vessels of different nations, among them two fine clipper ships flying our flag, we literally drifted over a hundred miles through "Ombay Strait," the large island of Timor on one hand, Flooris, Pantar, and many other islands on the other. One night, during a calm with a smooth sea, the *Mary Whittridge*, of Baltimore, drifted into the *Idaho* without doing damage to either vessel. Ten years later I saw this celebrated clipper ship with her masts removed, a coal barge, delivering fuel at the Boston Navy Yard. We anchored at the Portuguese port of Dilli on Timor for water and fresh provisions. It was to this place the English had banished many prominent participants of the Indian mutiny.

The passage from Dilli to Nagasaki was very tedious: calms, baffling and light winds, compelled us to go far to the eastward. We sighted the Island of Guam, little thinking that that spot on the far horizon would one day be one of our outlying possessions. After all our remarkable fast sailing at various times, our voyage from New York to Nagasaki, Japan, including stoppages in port, was over five months.

At Nagasaki I was detached and ordered to the double-ender cruiser *Ashuelot*. The *Idaho* was moored opposite the city. The hospital was established on board, and stores were delivered whenever a vessel called for them. The combination of a store and hospital ship was unfortunate. Discharging coal from the lower hold, with men seriously ill on the deck above, did not prove to be a success.

In July, 1869, I returned to the *Idaho*. Orders had been received to send the ship to San Francisco, where she was to be rebuilt and have engines again installed. In August we left Nagasaki for Yokohama with forty men as a deck force. A few days out of port we ran into the tail end of a typhoon, and lost several sails and spars. At Yokohama the crews of the *Maumee, Aroostock,* and *Unadilla,* gunboats, which had been sold on the station, their usefulness having passed, joined us, with all the men whose term of enlistment had expired, thus making a total of four hundred men. We were delighted with the prospect, that on our homeward passage, we would be able to handle and work the ship in a regular man-of-war fashion.

Returning home for their final examination, there also came on board Midshipmen W. E. Uhler, C. A. Copp, J. C. Hull, G. K. Adams, and G. K. Brower. Poor fellows, all were drowned in Yeddo (Tokio) Bay on board the steam sloop-of-war *Oneida,* when she was sunk with a large loss of life, January 24, 1870, by the Peninsular and Oriental mail steamer *Bombay*. The latter left the *Oneida* after the collision, never inquiring if assistance was needed.

Prior to 1869, and for many years later, the first teas of the season from China and Japan were carried to Europe, and some to America, in fast clipper ships. In this there was a great competition. The officers always received a handsome bonus for a successful and first arrival at the home port. The English tea-clipper ships *Thermopylae, Marathon* and *Elizabeth Nicholson* had, for

years, made swift passages to London. These ships and several others, laden with teas and ready for sea were at anchor at Yokohama near the *Idaho,* and would have sailed sooner, but the marine insurance companies refused to "clear them until the equinoctial typhoon season had passed."

The *Idaho* received orders to go to Hongkong, to take on board the stores left at the abandoned naval storehouse there, and then to sail for San Francisco. The commanding officer, Commander B. B. Taylor, represented to our admiral, Vice-Admiral Stephen C. Rowan, then in port, the status of the tea-clipper ships, and asked to be permitted to remain until they sailed. The admiral thought otherwise, and ordered the ship to leave September 20, which order was obeyed.

The following day we ran into, what was talked about for many years in the Far East, as the "*Idaho's Typhoon,*" were dismasted to the lower masts, and came near foundering. For some years this disaster was used as a text at the Naval Academy, for few ships had ever gone through the center of a typhoon or had registered a barometer as low as 27.62.

"The Laws of Storms," simple as they are, were not so well understood in 1869, as at the present day; yet every line officer in our wardroom had been for two and more years on the station, and had had experience with these revolving gales. About 7 a. m., September 21, with little change in the direction of the wind, the latter and sea increasing, and the barometer steadily falling, there was every indication of typhoon weather. It was suggested to heave the ship to, and watch which direction the storm was traveling. Had it been done, we would have left the center far to the eastward. As we had plenty of searoom, it was strongly urged at 10 a. m. "to put the ship on the starboard tack" and run for several hours before it. Late as it was, by the maneuver we surely would have escaped the center of the storm. Our captain, a young commander, was a stranger to the ship and station, was anxious to make a quick passage, and keep up the reputation of the ship for speed; he believed "we would soon out run the gale," and so we kept on our course and steered for the center of the storm.

For the better understanding, and to relate what took place during the typhoon, I will quote at the end of this narrative the ship's log, and its hourly reading of the barometer, also the letter

of the captain to the admiral reporting the disaster. The latter report was a compilation of those submitted by the executive officer, navigator, and the three watch officers. Before it was sent, the captain referred it to these officers, and several modifications were made.

Many incidents, that would no doubt make interesting reading, happened during the storm, but were not recorded in the ship's log book. We were too busy endeavoring to save the ship, and much of the log was written the next day. Critically examined, it may appear contradictory, but to us on the spot, it was clear and could readily be explained. I quote the log book and the captain's report exactly as they were written. Ship's logs of those days were little more than a very abridged statement of occurrences, the commanding officers required them to be so. Two midshipmen were stationed by the navigator to watch the barometers, they were also consulted by other officers, and their reading is correct.

One unmentioned incident came directly under my observation. All boats, with the exception of the third cutter hanging at the davits in the port waist, had been destroyed, or damaged by wind, sea, and falling spars. Midshipman Copp (drowned four months later on the *Oneida*) attempted to pass a hawser around this cutter. He was washed out of the boat, and, not catching the rope I threw to him, he remained for several minutes in the awful sea alongside while the ship was in the vortex of the storm, when a wave picked him up and threw him back on deck. It was more than surprising that, with falling spars and other dangers, officers and men were not killed or maimed. With the exception of several minor bruises, no person was injured during the storm.

At daylight the following morning, the sea and gale having moderated, we began to clear the wreck, and saved from the floating débris some of the broken spars and tacklings. Above the tops, the ship had hemp standing rigging. Fortunately the *Idaho* carried several spare spars, and by working day and night, cutting, fitting, sewing, and making many alterations, using top gallant-masts for topmasts, etc., in twenty-four hours the ship was under "jury rig," carrying topsails as courses, and topgallant sails for topsails.

In this disabled condition, the course was shaped for Yokohama, the ship being not only a wreck in spars and sails, but even more so in her hull and fittings. Decks and outside seams were

wide open, the oakum having been forced out by the straining during the storm. Many chain plates of the lower standing rigging had been wrenched from their fastenings in the hull. The vessel was hogged, her back being broken forward of the midship section. She leaked badly, and would have assuredly foundered, had she not been built and fastened like all our wooden warships, with broad, iron, diagonal braces, countersunk into the wooden frames. Merchant vessels are not so strongly built, and no doubt this is the reason one seldom hears that such a vessel has successfully passed through the center of a typhoon, or other revolving storms. In the majority of cases, they had joined "The Port of Missing Ships."

A few days after the storm, the new Pacific side-wheel mail steamer *America* (burnt in Yokohama harbor a few years later), crowded with passengers, on her maiden voyage from New York, via Cape Town to Yokohama and San Francisco, sighted us, and noticing the disabled condition, came near and inquired if assistance was needed. Our captain sent an officer on board with strict orders "to accept a tow to Yokohama, but not to ask for it." Captain Doane, of the *America*, declined this proposal and, after various interchanges of opinions, he steamed away for Yokohama and reported to our admiral our conditions and whereabouts.

The latter, with the flagship *Delaware*, the *Oneida*, *Iroquois*, *Ashuelot* and *Monocacy*, left port to search for us unsuccessfully, and, after a week's cruising, returned to Yokohama. The *Delaware*, having gone farthest to the eastward, met with very rough weather, lost several spars and boats, for all of which, we on the *Idaho* did not feel sorry.

We anchored off Yokohama September 28, 1869. Sailing up the bay before an easterly gale, the good old ship under her jury rig made fourteen knots per hour, as if to show to us for the last time what she could do. She never left the port again. There were no facilities to repair her; it would have required the rebuilding of her hull in a drydock, and as her frames were of green timber, the expense would not have warranted the outlay. She was condemned for active service, and was used as a permanent station ship at Yokohama until 1875, when she was sold to private parties, and used for several years longer as a rice hulk. Later she was broken up.

THE LOG OF THE *IDAHO'S* TYPHOON.

MONDAY, SEPTEMBER 20, 1869.

Barometer.

29.99 Left Yokohama at Meridian.

TUESDAY, SEPTEMBER 21, 1869.

29.97 *Midnight to 4 a. m.* Weather overcast with light drizzling rain
29.97 during last two hours of watch; fresh breeze from N'd. and E'd.;
29.98 clouds, cirrus, cumulus and nimbus; making 10 knots on course. At
29.97 4 changed course to S. W.

R. C. HOOKER, Lieutenant.

29.98 *From 4 to 8 a. m.* First part of watch rain, latter overcast but
29.98 pleasant. Wind strong from E'd, gradually hauling to the S'd, so
29.94 that by 6 o'clock, ship was sharp up on port tack. Set staysail,
29.96 spanker and royals; took them in with the top-gallantsails at 7.40. Carried away lee-main topsail sheet. Clewed down the topsails to double reef them. Very rough irregular sea running. Ship pitching moderately.

O. W. FARENHOLT, Master.

29.89 *From 8 to Meridian.* Weather pleasant. Fresh gales from S. E.
29.75 Clouds, cirro, cumulus, sea rough. At 8.45 changed course to S. W.
29.74 by S, double reefed the topsails fore and aft and took in jib. Latter
29.70 part more wind with very rough sea.

J. F. MERRY, Master.

29.61 *From Meridian to 4 p. m.* Weather overcast and rainy with stiff
29.61 breeze from S'd. and E'd.; clouds, nimbus, sea rough. At 1,
29.50 called all hands and close reefed topsails; hauled up and furled
29.33 courses. Furled mizzen topsail. Burst new fore-topmast staysail and set fore storm-staysail. At 4 took in and furled fore topsail. Barometer falling during watch.

C. M. ANTHONY, Lieutenant.

29.23 *From 4 to 6 p. m.* Ship laying to on port tack with close reefed
28.18 main-topsail, fore trysail and fore storm-staysail, helm hard up.
27.80 Weather overcast and rainy with gale from S. E. At 4 p. m.
27.72 got up a hawser, and rove it as a preventer main-topsail brace. At 4.30 the gale continued increasing with sudden and powerful gusts which pressed the sea down almost smooth, cutting off the tops of the waves, driving the spray fore and aft the decks and making a great noise; it was impossible at all times to breathe above the weather rail. At 5.15 the main-topsail split with a loud crackling, and simultaneously with this the main yard carried away in the slings, hanging in three pieces by the sail and lifts. Let go the lee brace and threw everything aback. Set the main-trysail and secured the wreck. Main-trysail blew into the ribbons. At 6 p. m. blowing a perfect hurricane with such a fearful howling that it was impossible to be heard at arms length.

R. C. HOOKER, Lieutenant.

27.80 *From 6 to 8 p. m.* Blowing a terrific hurricane with fearful gusts
27.62 from the S. E. At 6 the main-topsail yard went in the slings, the wreck hanging in the lower rigging to leeward. Soon after the fore and mizzen royalmasts went, followed by the main-royalmast and foretopgallant yard. Fore storm sail and fore storm staysail split and blew to ribbons. Attempted to get a tarpaulin in the weather fore rigging, but found it impossible to get on the forecastle. Third cutter was washed from the davits without and preceptible noise; another sea took the whale boat, broke it in two, half going overboard, the other half remaining in the mizzen rigging. At about 7.40 the gale suddenly died away, seas breaking over the ship carrying away, breaking the canopy railing, captains' pantry, armory, forward part of top-gallant forecastle and everything loose around the decks. Secured again the hatches with hammocks; rigged the pumps and attended them well; ship rolling and laboring very heavy in the frightful sea running, which often would break over the ship simultaneously forward and aft, shipping tons of water. Secured the remaining part of main yard and set to work to clear the wreck, the crew working very well. At 7.10 the barometer stook at 27.62.

O. W. FARENHOLT, Master.

From 8 p. m. to Midnight. At 8, lying to on port tack in the vortex of the storm, nearly calm with tremendous high, cross and con-
28.23 fused sea breaking over the ship the same as it would over a half-
28.62 tide reef, causing her to tremble violently and labor heavily.
29.23 Set spanker and mizzen staysail, got tarpaulin and boat awnings
29.99 in the main and mizzen rigging to bring ship head to wind; took in spanker and mizzen staysail soon after, as the wind increased. Maintopmast broke close to the cap, coming down in the lee main rigging. At 9.40 the wind increased, blowing as hard as before entering the vortex. Barometer at one time as low as 27.80, rising rapidly again at midnight, when wind began to moderate.

J. F. MERRY, Master.

WEDNESDAY, SEPTEMBER 22, 1869.

29.89 *From Mid. to 4 a. m.* Weather still overcast, with vivid flashes of
29.85 lightning and showers of rain at intervals, wind blowing a hurricane
29.80 from the N'd and W'd., got awning curtains and tarpaulins in the
29.78 weather riggings. Shipping seas over rails. No canvas set. Mizzen royal fell from aloft and struck the deck. At 1.30 men at pumps to free ship. At 2.15 wind moderated. Barometer rising and sea apparently subsiding. Swiftered in fore rigging to save foremast. Reefed spanker and rove new outhaul. Swiftered in main rigging. High sea running.

C. M. ANTHONY, Lieutenant.

"During rest of day cloudy and overcast with light airs from the southwest, rough irregular sea running, crew employed in clearing wreck and rigging jurymasts; ship standing up for Yokohama."

TUESDAY, SEPTEMBER 28.

Anchored off Yokohama.

VORTEX OF TYPHOON: LAT. 33° 5′ N, LONG. 137° 8′ E.

OFFICIAL REPORT.

U. S. STORE SHIP "IDAHO,"

At Sea September 25, 1869.

SIR: I have the honor to submit the following detailed account of circumstances attending the typhoon of the 21st inst. It has been compiled from observations of the ship's log, and from the personal recollections of the officers of this vessel. The indications of the gale date from 1 a. m. of the 20th, as the barometer was then falling regularly and continued to do so, until it finally started to rise from 27.62—at a time when few of us expected ever again to see daylight. A typhoon was confidently predicted by shore people in Yokohama before we left, and even while we were hove to for the *Ashuclot*, the weather was exceedingly disagreeable, gloomy and threatening; the pilot sapiently declared that nothing would result but a strong northeaster and that we'd get a good start on our course. During the afternoon the sky cleared up brightly, the wind held its direction as predicted by the pilot, and we carried studding sails until the evening. Throughout the mid watch of the 21st the wind continued the same, the ship making 10 knots per hour and at daylight a light drizzling rain set in. During the morning watch the sea became moderately rough, and during the forenoon, the ship began to ride uneasily although the force of the wind remained nearly the same being logged 6, 6, 6, and 8.

At Meridian the barometer stood 29.70. At 1 p. m. the topsails were close reefed (although it was remarked by several officers at the time that we could carry single reefs with top-gallant sails), however, the wind freshened so rapidly that before hands were "piped down," the mainsail and mizzen topsail were furled. At 3 p. m. the foresail was furled, it showing signs of weakness along the head. At 3.30 p. m. the fore topsail was taken in and furled. During this watch a new fore topmast staysail was bent, the fore storm staysail and trysail were set and at 4 p. m. the ship was laying to, on port tack under fore storm staysail, fore trysail and close-reefed main-topsail heading S. W. by S. with a moderate gale from S. E. and drizzling rain. The sea was quite rough but she rode very easily. The barometer stood 29.50, falling rapidly, and the gale was increasing with great violence holding steadily to its direction S. E. until 8.30 p. m.. Between 4 and 5 p. m., a hawser was rove as a preventer main-topsail brace, and stout jumpers were placed in the lower yard arms during the afternoon. After 5 p. m. the gale increased by terrific gusts to a hurricane. The main-topsail was now being made ready for setting close reefed in case the topsail should go. At 5.15 the main yard went in the slings with a thundering crash, the starboard arm banging furiously to leeward against the rail and rigging, breaking in two, one piece falling in the backstays and rigging, the other hanging by the sail, brace, and lift,

until frapped against the forward swifter. The port yardarm flew aback pressing against the weather rigging, which was relieved of strain by taking the jumper well forward and setting it up. Simultaneously with this disaster the main-topsail split with a succession of deafening cracks, sounding like volleys of musketry, and the lee half instantly disappeared, the lee brace was immediately let go, the topsail yard flew aback and the main trysail was set as quickly as possible. This sail did good service for nearly an hour when it finally blew to ribbons. The noise, fury, and impetuousity of the hurricane at this time was indescribable. The prisoners were released at 6 p. m. and worked manfully doing whatever they were told in securing wrecks and repairing damages, too much praise cannot be given to the crew, some of whom toiled like giants. The services of Boatswain Leeds (passenger) were invaluable, in cheering and leading on the men he was at all times the right man in the right place. Several main-top men distinguished themselves by securing the lee main yard arm from crushing in the ship's side. Awnings and curtains were placed in the weather rigging, the ship lay to almost motionless heeling over considerably. The gusts of wind now were sudden and all powerful, their fiendish howl deafening; the air composed of spray. The sea was pressed down smooth, the top of the wave cut clean off by the wind, and carried by the tempest in fine spray that blinded us and stung our faces painfully. At times the mainmast was invisible from the quarter deck, it was utterly impossible even to look above the rail, and below it we actually breathed salt water. Orders could not be made intelligible by word of mouth, the trumpet was useless, and work alone was accomplished by example. Men became sick from salt water which they imbibed, the tempest still blew from the S. E. and continued so until 7.40 p. m. Between 6.30 and 7.40 the following accidents occurred, the main-topsail yard, fore and mizzen royalmasts and yards, main-topgallant mast and yard, and fore-top gallant yard carried away; the fore trysail split, followed by the fragments of the fore-storm staysail, the sheet of which was steadied and strengthened by two strong tackles. The barometer stood at 27.82 when the main-topmast went close to the cap with a fearful crash, coming down with the whole debris of top hamper, starboard half of main top, all of which lodged outside of the lee main rigging.

The wire rigging held wonderfully, the mizzen top gallant yard, after hammering to leeward for some time, strangely thrust itself between the lee rigging and mast and jammed. The wreck of the main-topmast could not be cut away, and the ship began to labor heavily, shipping great seas with every lurch. One of those seas broke the whale boat in two, half of it went overboard, the other half remaining under the mizzen top being kept there by the force of the wind; the sea crushed and carried away the bulkheads of the cabin, top gallant forecastle, armory, canopy railing, skylights, hammock rail and everything loose about the decks. The ship went nearly on her beam ends, but in a moment righted and left the third cutter in the sea to leeward; the barometer had now fallen to 27.62; at 7.10 p. m. A sea came over the lee bow, carrying away and breaking rail and woodwork from forward, sweeping the gangway clean, bringing every-

thing aft; carrying away a second time the ward-room skylight, which was now secured with the cabin carpet, but still tons of water rolled below. The tempest was now as intense as it was possible for it to be, and its fury unimaginable. The darkness was impenetrable except occasional flashes of very sharp lightning, when the waves could be seen banked over one another, seething and boiling, high above and around the ship. The noise was like unearthly yells and the poor ship quivered in every timber.

Suddenly the mercury rose to 28.81 and with slight fluctuation continued to rise, with one fierce squall the tempest dropped almost to a calm and we were in the vortex. A confused cross sea was now runing, while puffs and squalls came from all points of the compass. The ship made water fast, the pumps were manned, the men singing cheerily and congratulating themselves the gale was over. Shipping great seas every instant, and being strained continuously, the seams in the deck opened fore and aft, the water poured through in torrents, damaging and destroying all books, clothing and stores, as well as all the personal effects of the officers in the wardroom and steerage, and the crew on the berth deck. The knees were breaking, bolts and chain plates drawing, stanchions fetching away, planks working, and decks and waterways gasping open. The forward part of the ship appeared to be working independently of the after part. During the calm she shipped a sea on both bows, starboard gangway and both quarters at the same instant, the decks were full of water and the ship trembled in the shock as if she would never rise again.

Expecting now the other half of this fearful gale, tarpaulins were now secured in the rigging, hatches rebattened, close-reefed spanker gotten ready, wreck cleared and secured, and at 9.20 the wind came out with redoubled fury and violence from the N'd. and E'd. striking us on the port beam. The ship bore up well and laid more quietly than during the first part of the typhoon. The wind backed to the N. W. and moderated rapidly, still the sea was very rough and the ship rolled fearfully when the wind went down.

This has been my personal recollection during this fearful and disastrous typhoon. Old sailors in the ship, some of whom have followed the sea for fifty years, say they never saw it blow so hard, and certainly it appeared impossible that it ever could have blown harder. I cannot close this report without again praising the excellent behavior of the crew, who worked as orderly and cheerfully as if in a top-gallant-sail breeze.

Very respectfully,

B. B. TAYLOR,
Commander, U. S N.,
Commanding.

THE COMMANDER-IN-CHIEF,
U. S. ASIATIC FLEET.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

MOBILE ARTILLERY IN ADVANCE BASES.

By MAJOR HENRY C. DAVIS, U. S. M. C.

All of the present arrangements for the defense of Advance Bases contemplate the use of some form of Naval Artillery as a part of the plan of defense.

The theory is excellent, to oppose attacking artillery with guns of equal or nearly equal power.

If, however, the Advance Base is to be at all mobile, and it is conceded such bases *must be mobile,* then some other form of artillery must be used. At least it must supplement the semi-permanent mounts and guns of the present outfits.

In the places contemplated in the different schemes of defense gotten up by various boards appointed for the purpose, no attention has been paid to the fact that such places are to be defended by anything other than troops and the naval guns which these different boards have recommended.

These guns range in caliber from the 3-inch semi-automatic to the 6-inch R. F. rifle. The platforms which it is contemplated to be used for the mounts of these guns are to be put in selected places, defending points at which it is thought most likely the enemy will land his raiding party. There they are stuck, and, of course, in the present day their location will not be a matter of secrecy very long, and in any case, that because the most likely spot for a landing is guarded, is the best reason for the enemy not coming to it. One cannot make plans too far ahead in warfare.

These guns are permanently located or they are semi-permanently located, in either case we lose their use at any place outside their arcs of fire. They cannot be used for defense on the landward side of the work they occupy, and they are a terrific strain on the personnel which places them in position as in the Naval service the personnel of the defense is to be used to place its guns.

In addition to this strain of getting guns, weighing as high as six tons, from a ship or transport, there is the greater strain of handling them on shore by man power assisted by such blocks and tackle as are sent along or at hand.

Even the most rapid and untiring work on the part of the men engaged will not compensate for the time lost with such a type of gun; nor will its power be so much in excess of a more mobile type as to make the trouble of placing it worth while.

It seems beyond doubt that the mobile gun, which means a gun with a carriage not so heavy but that it can be hauled around by man power, is the gun we must have for our advance bases.

What should this gun be? It took from ten to fourteen yoke of oxen to haul around the 4.7-inch gun used by the English in the South African war; and yet we have guns heavier in weight and no more powerful which we are to use in our landing operations and our advance base work, and which we, so far as I am able to find out, are to haul about by man power.

It does not enter into our scheme of advance base work to transport a gun for any such distances as this English gun travelled in the Boer war, but it is possible that a landing operation from the fleet may take a gun, from necessity, much further than is thought at the time of landing. We must have, therefore, a type which can be handled by some motive power which is easily transported on the ship or the transport which carries the gun and its limber.

The fire department of the city of New York are about to fit out their old horse-drawn engines with a tractor which has been perfected by an automobile expert by the name of Christy. This tractor is the solution of the rapid transport of heavy vehicles which are not outfitted with an engine as an integral part of the vehicle.

By means of a modification of the fifth wheel, the front wheels of the engine are removed and the tractor placed. The space taken up adds very little to the original length of the engine and the speed and power are greater than they got out of the three horses which formerly pulled the same machine.

One of these tractors fitted to the front wheels of the present 5-inch gun and limber will haul it any place horses can haul it, will take it there faster and will not be placed out of action by having its horses shot down.

Does it not seem that some such scheme as this gives a very easy and logical solution of the otherwise impossible problem of

providing an ever-ready method of transportation other than that supplied by the men?

There is ample room to store this or a similar type of tractor on board ship; or even two of them. They occupy only half of the space which a 3-inch field gun and carriage occupy.

The use of such a machine means also that stores and such things as are needed by a force on shore can be hauled from the wharves by some other means than by man propelled carts.

Certainly it is well worth the trial. Fitted to a gun as heavy as the 5-inch field gun we have an ideal gun for advance base work. A gun which can very easily take the place of the present 3-inch gun, and which will be more than twice as useful for landing and advance base work, *but such a gun must have power to move other than that supplied by the men.*

There is a case in the author's mind where guns are being placed for the protection of a harbor which may some day be used as an advance base. These guns are set on platforms of 18 x 14 x 18 timbers and the whole is set in a concrete bed. The guns were transported *six miles by man power assisted by block and tackle.* They were 6-inch guns and when placed offered no better defense than a mobile howitzer would have given, in fact not as good, because they *were placed,* and could only shoot towards the open sea.

Suppose an enemy had made a landing on the opposite side of the place these guns were in position? There is no means by which they could be used in their own defense, whereas, with mobile guns, they could be concentrated into a battery which would play havoc with any land attack approaching them.

In addition to the fact that a mobile gun could be rapidly taken from place to place when needed, they can be more easily concealed than a permanent gun mount, and they can be concentrated when needed, a feature which has been entirely overlooked in the case above mentioned where four guns are widely scattered.

It does not require a very profound knowledge of tactics to realize that a such a wide separation is faulty and more particularly when the widely separated guns form the only artillery defense at present provided or contemplated.

But we cannot confine ourselves to one case. It is none the less true, however, that the same principle holds in all cases. *Permanent artillery defense must have mobile artillery for its defense as well as infantry. The minute we contemplate the use*

of guns which are not mobile for advance base work, that minute the base is not a mobile base, and therefore should not be considered as an advance base so far as naval warfare is concerned.

If guns of this type are to be used, then we must assuredly add to the outfits for advance bases mobile guns and the means to make them *mobile in fact as well as in name.*

Even if we have no other means of transporting these guns than that supplied by the men of an advance base force, we must none the less *have the guns* and hope for the powers that be to give us some means of getting them about, which is practical for a naval outfit. Draught animals do not provide such a means for the for the navy, and so we come to the question already mentioned, either an automobile gun or a tractor to be used with the guns we need.

The naval guns at present used in the advance base work are not placed in their positions for use against the artillery of a ship but are to be used against the landing parties from a ship. This work can be done in much better style by a mobile gun for two reasons; first, the attacking ships will not know the location even approximately of such guns, and secondly, such guns can do their work and get away after exposing their position, or they can use indirect fire and not be located at all by the enemy.

With such a target as a modern gun emplacement makes, and with our knowledge of the quality of marksmanship of the navies of the first class, a gun or two of the type now used could not hope to do anything against a ship. The ship, on the other hand, could stand out of range and make things very warm for the crew of the gun mounted, as it would necessarily be, for advance base work.

Guns in permanent or semi-permanent positions could not keep small craft from coming in close enough to cut cables or shoot up store houses, etc., because their fire could be kept down by the heavier guns from the protecting ships. Mobile guns of a sufficiently heavy caliber could do this because they could change their position or, as stated before, could use indirect fire, and not expose themselves. The wonderful work done in the present day with this indirect fire must not be forgotten, and the observers would not want a better place to observe the fall of their shells than the water of harbor in which all the distances are accurately known.

At the battle of the Yalu, in the Russo-Japanese war, the Japanese concealed in one night seventy-two field guns and twenty howitzers from the Russians, and the Russian batteries which were conspicuously placed, were put out of action in thirty minutes. No target could be more conspicuous than boats loaded with men attempting to land, and nine out of ten guns of the type used at present for advance base work are by reason of their mounts very conspicuous.

Field guns or howitzers could be concealed from the ships supporting the landing and would, if efficiently served, put out of action any landing party, while the chance of the landing being effected is much more probable if we have to rely solely on guns placed in permanent positions, guns lacking mobility.

It is not the purpose of this article to decry the use of guns of a type requiring a semi-permanent mount, nor does it enter the author's thought that such guns are not needed, but to make these immobile guns efficient *we must add to their defense guns of a mobile type.*

We must bear in mind the fact that an advance base for the use of the navy will probably be seized in a night or a day. We cannot waste the time in getting the ponderous naval guns off the ships making the seizure. We must have guns designed for the purpose and they must be fitted so that when the work of assembling them and getting them off the ship is completed, work which would be assisted by all the mechanical apparatus on a warship, they can be run by their own power to their positions. We must not call on men, who will probably be needed on the ships, to go off on such an expedition as dragging a dead weight of five or six tons various distances over unknown country.

We must have guns which can be rapidly moved from one place to another, guns which are not tied down when in place and useless except in a very limited arc of horizontal train.

The design of the naval ship's gun is against it for this work. The extreme elevation for which they are generally designed is fifteen degrees, and it is quite likely that we will want to use a still greater elevation to accomplish anything with indirect fire.

If our contemplated naval bases in the Pacific are isolated by having the cables cut, and if we are to be in ignorance of their fate in the event of war until some news can be gotten by our scout cruisers or other fast ships, we must certainly give these

bases the means of defending themselves against anything less than an army of invasion. They must be provisioned and equipped with all the munitions of war likely to be needed in a siege, and we must above all *give them the means to make even, an attack by a small army, a thing of very serious aspect to the enemy. A few guns or many guns which are put down in permanent positions will not accomplish this end. They must have mobile troops, and above all, mobile artillery, because the most powerful battery in the world is helpless in the face of a successful land attack. The rear is a very weak place in their armor.*

No determined commander has ever been prevented from entering a harbor by the mere presence of coast defense guns, and no commander worthy of the name ever will be. And once he is in past the defending forts the harbor and all it contains is his. But with a land force backing up the coast defenses, the commander is rash indeed who will undertake to ignore its presence and run past the guns. Only defeat awaits him, unless he has his own army to occupy the army of the defenders.

It is not presumed that any naval defense of an advance base will go into the larger operations of war where armies are concerned. Their defense must be a part of the training of the military branch of the navy, the Marine Corps, and in this training we must consider that the service in time of war will be one which must be rendered quickly, efficiently, and we almost say silently. To do this we must have the most powerful means at our disposal considering the peculiar conditions under which we will have to work, and one of the things which will add greatly to the efficiency of our men will be to provide them with an efficient mobile piece of artillery for this special work.

Brief though these thoughts are, I will now leave the subject, but I feel that it cannot be done without making a powerful appeal to the powers at the Department to design and put into service for this most important work of advance base defense, the *mobile gun* we need. It may have been done but it is not within the knowledge of the writer.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON SIGNALS FOR USE IN HYDROGRAPHIC SURVEYING.

By CAPTAIN A. RUST, U. S. Navy.

As the rapidity with which a hydrographic survey can be conducted depends largely on the time saved in building the signals for extending the triangulation and controlling the hydrography, after two years test I have found the steel towers described herein vastly superior to the wooden signals in common use and employed at first by me, for the following reasons:

(a) They are more economical; for not only is the first cost less than that of wooden signals of the same size, but as they are made of galvanized steel, the large towers having composition bolts and nuts ten feet above the bottom, they will last indefinitely with proper care, and may be readily taken down and set up at other stations.

(b) There is a great saving of time and fewer men are required. A 60 foot steel signal tower may be put together, erected and decorated in one day, whereas a 60 foot wooden tower will take a week under the conditions usually met with, including the time taken to cut and fit the timbers.

Boatswain Thomas James, U. S. Navy, in charge of a party, erected, guyed and decorated a 60 foot steel signal tower on a sand shoal and the party was on its way back to the ship in 5½ hours. This is the best time ever made, I believe, though the work was done under most difficult conditions, the shoal being awash at the time.

(c) The steel signals are not disturbed by fishermen or the natives on shore as the wooden ones are liable to be.

(d) The small steel signals 30 or 40 feet high may be placed on shoals where the water is too deep to erect wooden signals.

(e) The steel signals may be made sufficiently rigid to support the transit directly without an interior instrument stand when

occupied, though when the distances are very great a small tower may be erected inside the large one for an instrument stand.

(f) The steel signals are not so liable to be blown down, as the planks and canvas put on for making them visible at long distances being structurally weak, will blow away first, provided the signal be properly guyed, but in case these steel signals are blown down they are not injured to any great extent, unless there are rocks or stumps for them to strike in falling. It is difficult to guy up tall signals located on sand bars so they will stand a heavy wind and sea, and four 60 foot signals thus placed I found down at the beginning of the next season but practically uninjured. Some of the angle irons were bent but the blacksmith straightened them again in a short time.

Four sizes of signal towers are used by the Cape Cruz-Casilda Survey Expedition: 30 and 40 foot tripods and 60 and 80 foot 4-post towers. The 60 foot tower is shown on Drawing KD-58 furnished by the Aermotor Company, 12th and Rockwell Streets, Chicago, Ill., the firm which furnishes these towers. (See Fig. 1.) The 30 and 40 foot towers have 2-inch pipes at the top to admit a galvanized pipe for a flag-pole. Experience shows that these are more convenient than the heavy wooden poles. The upper ends of these 2-inch pipes should be threaded in order that a brass casting, which is portable, may be screwed to this pipe to which a wooden platform is attached to support the theodolite. I have been informed by the builders that a 3-inch pipe is the smallest that can be used with the 60 and 80 foot towers, therefore to the 3-inch pipe should be screwed a reducer into which a short piece of pipe the same size as that used for the 30 and 40 foot towers should be screwed and threaded on its upper end to receive the portable casting supporting the instrument.

To recapitulate:

(a) In ordering these towers specify for the 60 and 80 four post towers that they be fitted with 3-inch pipes at the top with reducers, and a short piece of pipe the same size as that used for 30 and 40 foot tripods, and be threaded at both ends with standard pipe thread and screwed into the reducer.

(b) Specify for all towers, 30, 40, 60 and 80 foot, the angle irons connecting the bottoms of the anchor posts are to be furnished as shown on Drawing KD-58.

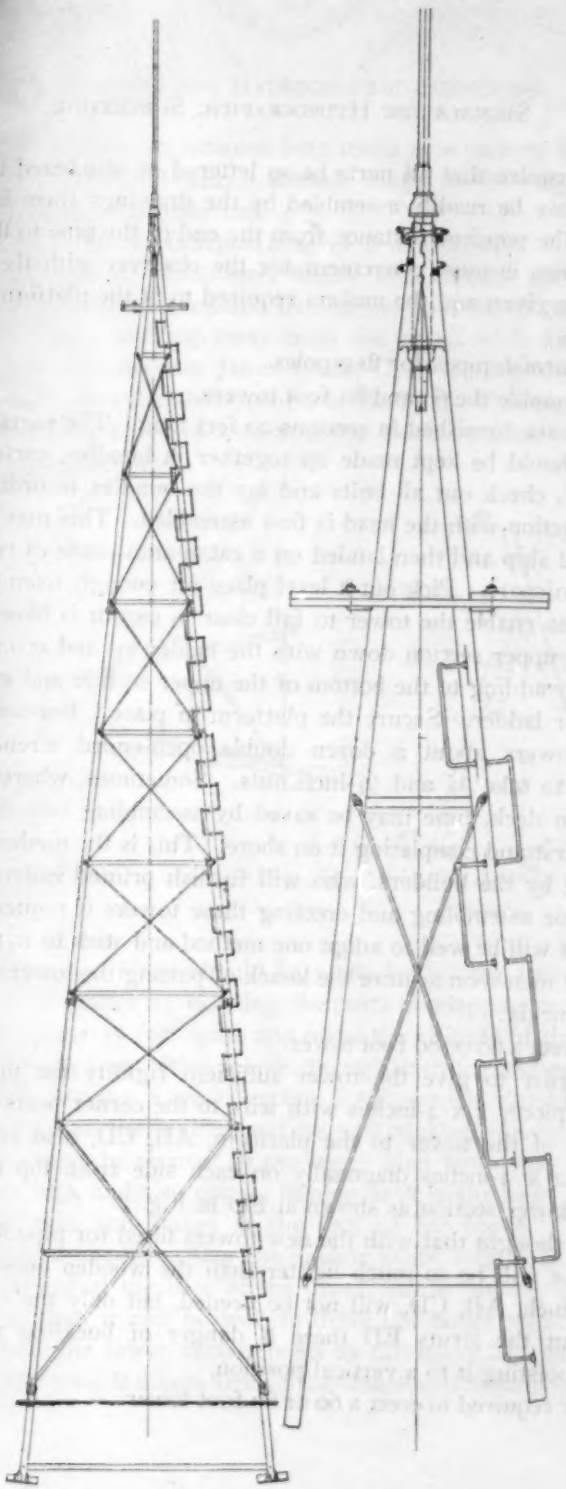


FIG. 1.—DRAWING KD-58.

(c) Require that all parts be so lettered or numbered that the towers may be readily assembled by the drawings furnished.

(d) The required distance from the end of the pipe to the platform which is most convenient for the observer with the transit should be given and the makers required to fit the platform at this distance.

(e) Furnish pipes for flag-poles.

To assemble the 60 and 80 foot towers.

These are furnished in sections 20 feet long. The parts of each signal should be kept made up together in bundles, each section by itself, check out all bolts and lay the bundles in order. The upper section with the head is first assembled. This may be done on board ship and then landed on a catamaran made of two boats lashed to spars. Pick out a level place far enough from rocks or stumps to enable the tower to fall clear in case it is blown down. Lay the upper section down with the ladder up and complete the tower by adding to the bottom of the upper section and attach the steps for ladder. Secure the platform in place. For assembling these towers about a dozen double open-ended wrenches are needed to take ⅜ and ¼-inch nuts. Sometimes, where there is room on deck, time may be saved by assembling two sides of a tower first and completing it on shore. This is the method recommended by the builders, who will furnish printed instructions in detail for assembling and erecting these towers if requested. As a rule it will be well to adopt one method and stick to it, as in this way the men soon acquire the knack of putting the towers together very quickly.

To erect a 60 or 80 foot tower.

In order to give the tower sufficient rigidity for up ending, secure pieces 2 x 4-inches with wire to the corner posts from the bottom of the tower to the platform, AB, CD, also secure two struts 2 x 4-inches diagonally on each side from top to bottom of the lower section as shown at ED in Fig. 2.

It is thought that with the new towers fitted for pipe flag-staffs, as these will be so much lighter than the wooden ones, that the 2 x 4-inch, AB, CD, will not be needed, but only the struts ED. Without the struts ED there is danger of buckling the tower when hoisting it to a vertical position.

Gear required to erect a 60 or 80 foot tower.

(a) A pendant 20 fathoms long made of wire rope 2 inches in circumference, fitted with a thimble in the lower end and stout sister hooks in the upper end.

(b) A tackle 50 fathoms long of 2-inch Manila rope, with a steel 3-fold upper block, steel double lower block, standing part made fast to lower block and hauling part through a steel snatch block, the men walking away from the signal while erecting the same. Chief Boatswain James Glass, U. S. N., found after some experiments that the above gear was the best. This tackle should be unrove when not in use, and the blocks washed with fresh water, dried and oiled.

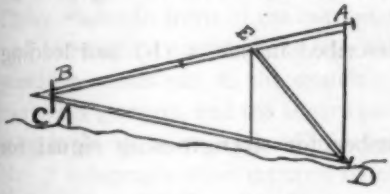


FIG. 2.

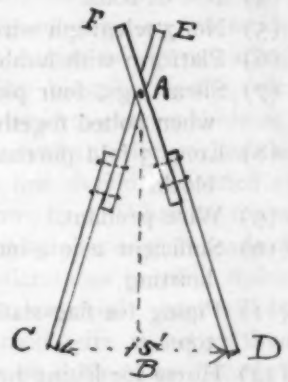


FIG. 3.

(c) Shears. These should be made by bolting two pieces of 4 x 4-inch together for each leg, the parts overlapping well, spread the heels about 15 feet apart and make the altitude of the triangle ACD,AB—35 feet. Bore a hole through each leg and put a stout bolt at A leaving a good crotch FAE, which should be well rounded out at the bottom and be well slushed, or chocks with rounded scores be secured to the legs. Nail temporary braces to the shear legs, and also place a lashing at A in the large angles.

(d) Planks and stakes at the foot of the tower. With the steel angle irons connecting the anchor posts, long planks should not be needed at the base of the tower, but to prevent the tower from skidding, it will be well to drive old boiler tubes or stout stakes near the lower anchor posts as the tower lies on its side, and to take loose lashings around the stakes and these posts, and if

the lumber can be had it is well to bolt short pieces of heavy plank, 3 x 12-inches to the foot of each anchor post to prevent the legs sinking into the mud or sand when the ground is soft.

List of articles required to erect a 60 or 80 foot steel tower.

(1) 2 heavy mauls or sledges.
(2) Stakes or old boiler tubes. A supply of tubes may generally be found at any Navy Yard and they will be found very useful.
(3) Frame work of the signal made up in bundles, each section to itself, and carefully checked up by the blue print, and tagged.
(4) Box of bolts.
(5) No. 7 telegraph wire for guys.
(6) Platform with lumber for enlarging same if necessary.
(7) Shear legs, four pieces 4 x 4-inches, 40 feet long over all when bolted together.
(8) Long 3-fold purchase, described in par. 5 (b) and leading block.
(9) Wire pendant.
(10) Sufficient 2 x 4-inch lumber for strengthening signal for hoisting.
(11) Piping for flag-staff of the proper size to fit the pipe at the top.
(12) Horse for lifting head of signal tower for first pull.
(13) 2 heaving lines.
(14) 4 machetes.
(15) 2 axes.
(16) Hammers, nails, and all wrenches available.
(17) Planks, old canvas, paint and white-wash, if signal is to be decorated, also small stuff for stops.
(18) Flag and halliards.

N. B. Muster all tools before shoving off, and have a station bill for the party and hold each man responsible for providing and returning certain tools and gear.

To erect the 60 or 80 foot towers.

Great care must be taken to have everything rigid and well braced in order not to buckle or drop the tower when it starts from the ground. When the ground is soft or sandy take the strap for the lower block of the tackle around a spar in front of which stakes or old boiler tubes are driven at an angle, drive a second

row opposite, and lash the stakes or tubes together as shown at AB, Fig. 7. Sometimes it will be found convenient to use a steamer's anchor and back it up in the same way. Lift the head of the tower from the ground and rest it on a wooden horse. Take the end of the pendant around the tower just below the platform and hook the sister hooks around its own part and mouse them well. Hook lower block of tackle to a strap taken around several boiler tubes or stout stakes driven well down, well backed, and placed as far from the head of the tower as the length of the tackle when overhauled will allow. Place pendant in the crotch and upend shears and place the feet near the bottom of the tower, but far enough away for the head of the shears to cant a little towards the head of the tower. Get a good strain on the tackle and see that everything is well secured. Attach two guys leading off at angles of about 45° from the tower to stakes in the rear. Drive stakes in front of the bottom angle iron* to prevent skidding, and bend a line to the shear legs to prevent them falling when the pendant comes out of the crotch. This line should be tended as the tower goes up, and the shears eased down by it. When the tower is up it should be well guyed by a sufficient number of guys made of No. 7 telegraph wire secured to old boiler tubes or stout stakes and set up with Spanish windlasses. At least eight guys will be required for these towers. The telegraph wire is better than wire rope or strand, as not only is it not so liable to be disturbed by the fishermen and natives on shore, but the guys made of several parts may be more easily set up taut. The guys should be secured near the top of the signal, just below the platform is a good place, so as not to interfere with hoisting the planks for decorating the signal to make it visible. Anchor stakes should be driven at each corner and secured to the anchor posts by wire lashings. To make the tower rigid for occupation, wire diagonals should be put in between the legs and set up with Spanish windlasses. Procure 24 planks each 16 feet long, 6 inches wide and ½ inch thick, and 6 pieces 2 x 4-inches, about 16 feet long. Nail 12 of the 6-inch planks at right angles to 3 of the 2 x 4-inch, spacing the 6-inch planks about 2 or 3 inches apart (not more than three inches). If the signal is to show against the sky, paint these planks black, if against the land, use the white paint or white-wash. Carry

*Lash a stout spar to this angle iron from corner post to corner post, or to the anchor posts, for these stakes to bear against.

a tackle to the top of the signal, bend on the frame work so that the 6-inch planks will be vertical, bend on tripping line and hoist away and secure the frame-work close up under the guys on one face of the tower, and the other at right angles to the first one. We thus have an area 16 feet square visible 10 miles with the naked eye.

Flags in a region of variable winds are very unsatisfactory, but it is necessary to use these until the occupation of the signal has been completed, when beacon heads made of planks 6 x ½-inch, and from 8 to 12 feet long placed on the flag-staffs were found very good. Another very good decoration for the top of a signal in place of a flag, and one that can easily be removed, if necessary to occupy the signal, was a canvas rig which was made like an old fashioned navy target with three wings making an equilateral triangle of 21 feet on a side from any direction. These wings are spread out by riggers nailed to the platform. A large supply of old canvas should be carried which should be painted or white washed when used instead of lumber for decorating signals.

Lowering and transporting 60 and 80 foot signals.

Before lowering these it is necessary to rig the wooden frame work and diagonals used in erecting the signal, otherwise the legs are liable to buckle, the tower dropped and more or less injured. To transport the 60 and 80 foot towers it is necessary to take them apart except the top section which need never be disturbed, but brought off on a catamaran made of two boats and be triced up along-side or hoisted on board ship.

Erecting 30 and 40 foot signals.

The 30 and 40 foot steel tripods may be easily put together in the gangways on board ship and be triced up alongside, three or four each side. These need never be taken apart when once on the working ground. They are sent ashore on two boats with spars lashed between and may be erected and decorated in a couple of hours, and are very convenient for use on shoals where the water is smooth and from 6 to 8 feet deep, provided the bottom is of such a nature that long stakes may be driven down to which the guys may be made fast.

By using the steel signals in place of wooden ones the amount of work done by a given party in a given time may be trebled.

Floating signals.

For off shore soundings where the water is shoal enough to moor or anchor them securely, excellent floating signals may be made as follows:

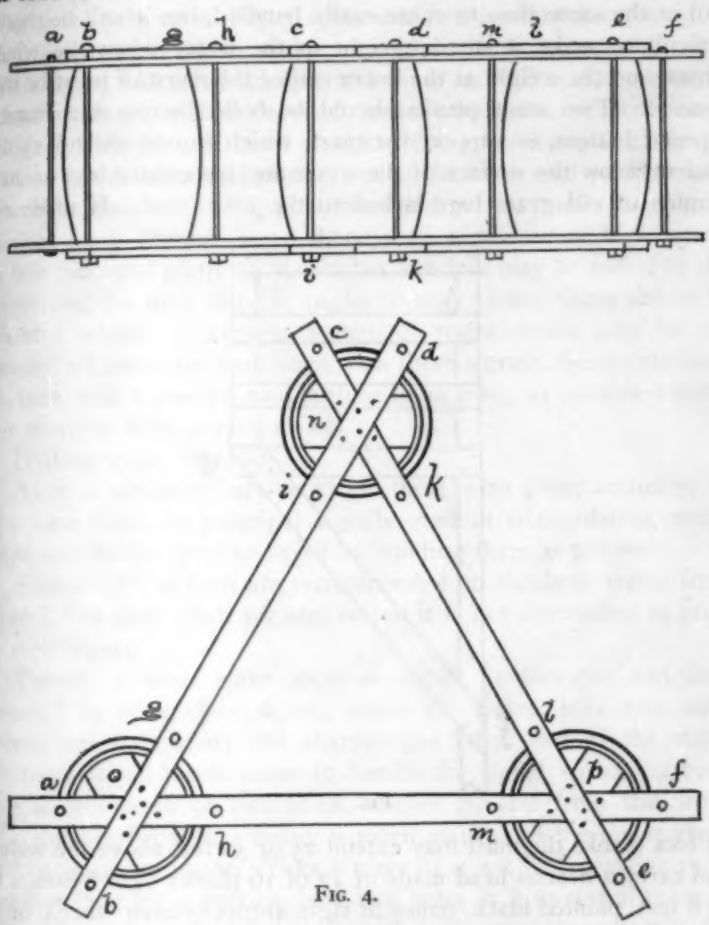


FIG. 4.

Procure three empty barrels, test them to see that they are perfectly tight. Make two equilateral triangles of planks 2 x 6 inch x 12 feet long, place the three barrels between these at the vertices of the triangles, and secure the triangles together by six bolts made of ½-inch iron rod, a, b, c, d, e, f. If these bolts do not seem to make the structure sufficiently rigid for rough water, use six more at g, h, i, k, l, m. Filling pieces, n, o, p, for the heads

of the barrels should be fitted to prevent the barrels working adrift. If the barrels are placed close together the signal will be more suitable for use where there is much wind or sea, and will at the same time be more easily handled, but it will be more difficult to make it stand upright in the water when the wind blows, and the weight at the lower end of the flagstaff must be increased. Two stout planks should be bolted across the frame, top and bottom, to support the mast, which should extend 15 or 20 feet below the surface of the water and have about 150 or 200 pounds of old grate bars lashed to the lower end. If made of

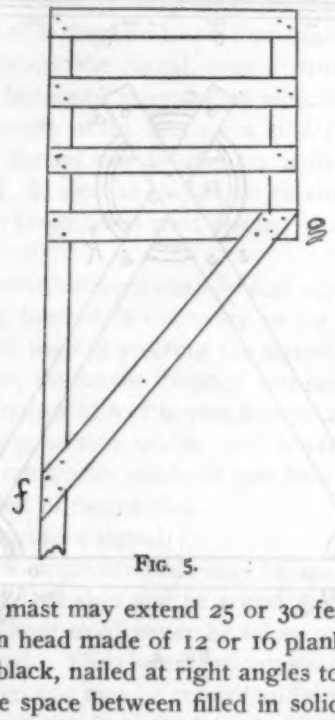


FIG. 5.

12 foot planks the mast may extend 25 or 30 feet above the water and carry a beacon head made of 12 or 16 planks ½ x 6-inch x 6 or 8 feet, painted black, nailed at right angles to each other 6 or 8 on a side, with the space between filled in solid with black cloth. This increases the visibility very much. Three triangular wings may be secured below this like an old fashioned navy target. A strap of wire rope or chain should be secured around the flag-pole above the upper part of the platform to which the anchor chain is secured with a pelican hook moused with wire. The mast should be made of two pieces of 3 x 4-inch or 4 x 4-inch bolted together. It will be found that by placing the barrels tangent to each other,

or nearly so, that the float may be more easily handled, but then instead of a beacon head it will be found necessary to modify this by pacing all the planks in one plane only and nail them to the flag-pole as shown in Fig. 5, otherwise in a fresh breeze the signal will list over so far as to lose much of the height of the mast. This signal will stand upright and show up well except when the observer is directly to leeward or to windward. Weave black cloth in between horizontal planks. Nail a vertical plank ½ x 6-inches to the horizontal planks, and at the lower end of this plank secure a brace to the flag pole, see f and g. To render this signal visible for a distance when directly to windward or to leeward, a few pieces of plank ½ x 6-inches x 8 feet may be nailed to the bottom of the mast at right angles to upper ones; these should be painted white. A regular system of triangulation may be extended off shore on soundings with these signals, occupying each in turn with a sextant, and cutting in as many as possible signals on shore or those on the shoals.

Hydrographic signals.

As it is not necessary to locate these with great accuracy, as the case with the principal signals used in triangulation, much time and lumber may be saved by building them as follows:

Signals of this kind are recommended on shoals in water from 6 to 8 feet deep when for any reason it is not convenient to erect a steel signal.

Provide a stout stake about 6 inches in diameter and long enough to stick about 6 feet above the water, bore two holes about one foot apart and sharpen the lower end of the stake. If there is too much water to handle the signal without a boat, rig a catamaran of two boats, anchor it, and from this drive the stake down with a heavy wooden maul until the top is about a foot from the water. Take a piece of 4 x 4-inches about 15 or 20 feet long for a derrick, bore two holes in it to match those in the stake and secure a tail block with a line rove through it to the other end, or better still put a sheave in the upper end of this spar.

Provide two long ½-inch bolts long enough to go through the upright for the signal 3 x 3-inches, or 4 x 4-inches, the stake and the derrick of 4 x 4-inches, put a bolt through the three as shown in Fig. 6, upend the derrick, and put the other bolt through from the opposite side of the stake. Bend the line to the mast at a distance from the first bolt to the center of the sheave in the derrick.

Nail on the cross planks ½ x 6-inches x 8 feet and weave the cloth in to fill up vacant spaces which should be tacked on with plenty of battens to hold it, take the wire around for the guys, and hoist the beacon upright and after securing the guys unship the derrick and secure the heel of the mast with the second bolt.

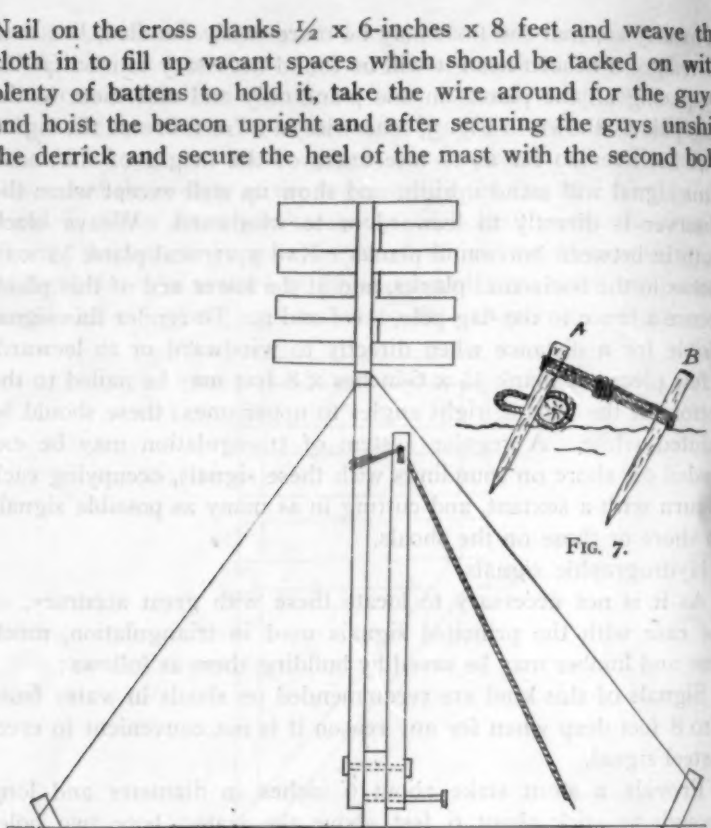


FIG. 7.

FIG. 6.

The black beacon head made solid with cloth makes a fine signal on water, and shows up well against the sky; when a single pole signal like this is used on shore with trees or bushes as a background, a white beacon or three triangular wings hauled out by means of the guys makes an excellent signal and one that may

be quickly built. On shore a hole may be dug to hold the lower end of the mast instead of the stake. These signals have been described to the smallest details, as experience shows that much time may be lost by the signal building parties in trying unnecessary experiments, and thus greatly retard the work.

When prominent trees or hummocks are used for signals they should be marked by beacons or flags to distinguish them before they are cut in. A piece of 2 x 4-inches, or a pole cut in the woods with boards nailed across at right angles to form a beacon with a flag above or below is a very good distinguishing mark. Empty flour barrels white washed or painted black make good marks. As each hydrographic signal is built it should be occupied with a sextant even though a transit be used later, and all signals in sight from it cut in, a regular angle book being always carried for recording these angles.

In erecting signals for the control of the hydrography it is well to remember that it is better to have too many signals than too few. The soundings are delayed very much when the steamers are compelled to stop work to build signals.

Marking centers.

The center of a tall signal cannot be accurately located with a plumb bob if there is any breeze, so as a rule it is better to use a transit. Set up, level, and bisect the flagstaff, and line up two pegs so that the center is between them. Shift the transit so that a line to first pegs will be at right angles, or nearly so, to the first line, and line up two more pegs in the same way, and with cords connecting the two pairs of pegs, find the center and drive an old boiler tube, first flattening the lower end, until the end is nearly flush with the ground and fit a plug in the end of tube and mark the center with a tack. Dig a hole around the boiler tube and having straightened up the tube so that the back comes at the intersection of the cords, place a section of terra-cotta pipe with the flange down as far below the surface as desired, then fill around the tube with cement. Drive the plug down in tube, fill end with cement and place a copper nail in center. This forms a mark that no one can remove without considerable work. Suitable reference marks should be established also, for while the iron tube will last for many years it will in time go, and it may be necessary to dig for the sub-surface mark. If no terra-cotta pipe be available, place a box 6 inches square and two feet long around the

tube and fill in with cement. If the top of the terra-cotta pipe be left above the ground the earth should be heaped over it and a pile of stones placed over the mound if they are found to be near.

Sub-surface marks, unless they have pipes driven close to them, are hard to find unless the reference marks are piles of stones, as stakes rot in a few years. When no pipes are available to use with the cement mark, it should be made so long and heavy that it cannot be readily disturbed. While the cement is soft, place a copper nail in it to mark the center.

A signal record book should be kept in which the officer or surveyor in charge of the triangulation should be required to make an entry over his signature describing all center and reference marks for each signal built, with sketches showing their locations and giving angles and true bearings to prominent objects.

Buoy for floating signals.

In Fig. 8, at A and B are shown views of a buoy for floating signals which will be found more convenient to handle than the raft shown in Fig. 4. If made of the dimensions given in Fig. 8, 3 feet in diameter and 2 feet high, it will support about 600 pounds dead weight. A similar buoy 3 feet in diameter, 2½ feet high will support about 800 pounds dead weight. These buoys should be made of galvanized iron or steel about 3/16-inch thick or 7½ pound plate.

a,b,c, Pad-eyes to which slings for handling buoy are made fast.

d, Pad-eye for mooring chain or pendant.

e, Ring for slings.

f, Pipe at least 4 inches in diameter for mast. This mast should be in two sections, the upper section with the beacon head is bolted to the lower which passes through f, and has about 200 pounds or more of ballast on its lower end and extends 15 or 20 feet below the water.

M, Man-hole.

The mast for this buoy had best be made of two sections of galvanized iron pipe, the lower section of the proper size to pass through f, with a collar or flange around its upper end to prevent its slipping through f. The upper section slides into the lower when the buoy is not in use. When the buoy is in use the upper section is kept in position by a through bolt above the flange. A cast iron ballast ball weighing about 200 pounds, with a short section of 4-inch pipe cast into it should be attached to the lower

end of the lower section by a through bolt. The ballast balls will be found much more convenient than the improvised ballast made of old grate bars. The diameter of cast iron sphere weighing 200 pounds is about 11.3 inches.

FIG. 8.

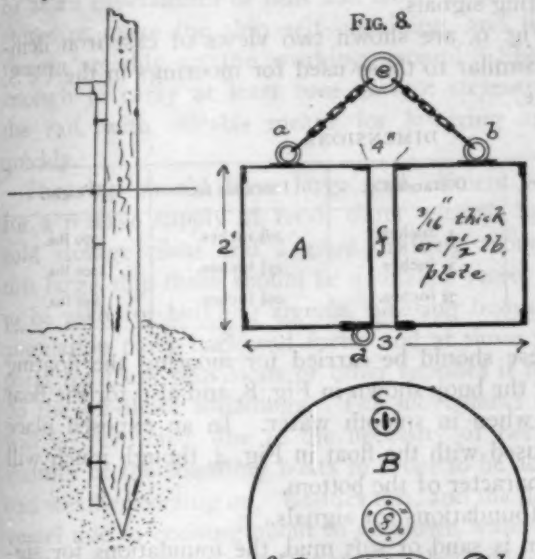


FIG. 10.

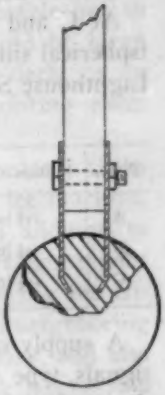
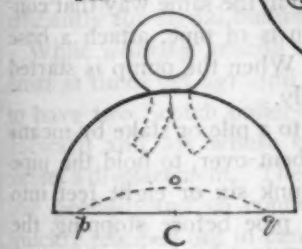


FIG. 11.



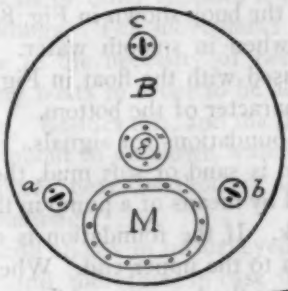


FIG. 9.

A sketch of a ballast ball is shown in Fig. 10. While the lower section of the mast should always be made of a pipe, the upper section may often be conveniently made of wood.

Boat chain made of iron ⅜-inch in diameter should be heavy enough for any of the signals described herein, and the chains should be galvanized. When the water is deep, wire rope,

on account of being lighter, should be used. Before having the rafts or buoys made, figure out from the approximate depth of water the weight of chain or wire pendant that will be needed and increase the size of the buoys if necessary.

Sinkers for floating signals.

At C and D, Fig. 9, are shown two views of cast iron hemispherical sinkers similar to those used for moorings in the U. S. Lighthouse Service.

DIMENSIONS.

Type.	Radius of Sphere.	Distance Co.	Distance pq.	Weight.
A	11½ inches.	3 inches.	20½ inches.	770 lbs.
B	13½ inches.	3 inches.	23½ inches.	1200 lbs.
C	15½ inches.	3½ inches.	26½ inches.	1850 lbs.

A supply of these should be carried for mooring the floating signals, type A for the buoy shown in Fig. 8, and also for the float shown in Fig. 4, when in smooth water. In an exposed place type B should be used with the float in Fig. 4, though much will depend upon the character of the bottom.

Pumping down foundations for signals.

When the bottom is sand or soft mud, the foundations for signals may be planted by means of a pump in the same way that concrete piles are sunk. If the foundation is of pipe, attach a hose from a steam pump to the upper end. When the pump is started the pipe will sink into the bottom rapidly.

In the same way, by attaching a pipe to a pile or stake by means of wire spikes driven alongside it and bent over, to hold the pipe securely but loosely, the pile may be sunk six or eight feet into the bottom with ease. Withdraw the pipe before stopping the pump, otherwise if working in sand, it cannot be done on account of the sand settling around and filling up the pipe. (See Fig. 11). Keep the ship or tender in position by kedges off either quarter if necessary. I am informed by Commander J. H. Hetherington, U. S. Navy, that he has planted piles 12 inches in diameter in this way.

General remarks on the proper outfit for an efficient surveying expedition.

In the past, as a rule, surveying ships have been too small to be economical and efficient. A ship for this service should be large

enough to carry an ample supply of coal and provisions, lumber, old canvas, old piping and boiler tubes, and other material which may be picked up at a navy yard without cost, and which would be expensive to obtain on the working ground, either in money or at an expenditure of time and labor, as well as enough regular stores to make the ship self-sustaining, and thus enable her to remain steadily on the working ground. She should be large enough to carry at least four 40-foot steamers on deck, or on the rail, with suitable means for lowering and hoisting them quickly.

The ship should have large and efficient evaporators, tanks for a reserve supply of fresh water, electric lights, ice machine, cold storage plant and a good drafting room. In addition to this large ship there should be a smaller vessel to act as a tender to be used for building signals, planting buoys, carrying the triangulation party back and forth, and at times go to neighboring ports for fresh provisions or other supplies if necessary, and also do the off-shore soundings. The movements of the larger ship will be restricted, due to the necessity of her remaining in the vicinity of the sounding boats in order to be accessible in case of bad weather coming on. Besides this, and the danger to the larger vessel due to cruising about in unknown waters, she cannot ordinarily approach sufficiently near the shore or to shoals to be used efficiently for signal building.

While working around shoals in unsurveyed waters the tender must at times get aground, therefore, in case she does not happen to have two Scotch boilers, she should be fitted with water tanks forward and aft whose capacity is at least 4 per cent of the vessel's displacement. These should be kept full when on the working ground, and so connected to the pumps that they may be quickly pumped out in case of grounding. Cloud shadows on the water often present the appearance of shoals, and are so deceptive that they will worry one considerably at first, and when the sun is ahead or right overhead, it is almost impossible to distinguish a shoal by eye; the lead is the only thing to depend upon, but with the greatest care, when working among reefs, or when the water shoals suddenly, the tender is at times liable to get aground, hence the great utility of the water ballast. If in a territory where you suspect rocks keep a boat ahead of the tender unless working in a protected place.

THE LANGLEY MEMORIAL.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

AVIATION TO-DAY,* AND THE NECESSITY FOR A NATIONAL AERODYNAMIC LABORATORY.

By Captain W. Irving Chambers, U. S. Navy.

The status of aviation in the world to-day may be summarized as follows:

The work of established aerodynamic laboratories has transported aeronautics generally into the domain of engineering, in consequence of which aviation has reached a stage of development wherein the methods of scientific engineers have replaced the crude efforts of the pioneer inventors.

The development of aviation for marine or naval purposes has naturally been somewhat delayed, but, inspired by the early demonstrations of our navy, the naval powers of the world are now devoting large sums of money to this phase of development. It may be asserted that although the aeroplane has not yet arrived at the state of perfection required by all the work contemplated for it in naval warfare, yet it is sufficiently advanced to be of great service in many ways, should it be required for use in emergency, and its satisfactory development for extensive use is fairly in sight.

Those who are engaged in the development of aviation for war purposes do not pretend that it is going to revolutionize warefare, but it has been fully demonstrated that of two opposing forces, the one which possesses superiority in aerial equipment and skill will surely hold a very great advantage.

Contemplated Uses of Aeroplanes in Naval Warfare.

A. They can be carried, stowed, and used by all large ships.

(1) To reconnoiter an enemy's port, or to search out his advanced bases and to assist in the operations of a blockaded or a blockading force.

* November 12, 1912.

(2) To locate and destroy submarine mines, submarines and dirigibles, and to assist in the operations of submarines and torpedo boats.

(3) To damage an enemy's docks, magazines, ships in repair or under construction, dirigible sheds and other resources.

(4) To provide means of rapid confidential communication between a fleet commander and the commanding officer of a co-operating force on shore, or of the commander of another fleet or division.

B. They can be carried by all scouts and large cruisers.

(5) To extend the "eyes of the fleet" in naval scouting.

C. They can be carried, with ample supplies and camp outfit, on board any naval supply auxiliary,

(6) For scouting at advanced bases and for extensive use with expeditionary forces.

WHAT IS BEING DONE ELSEWHERE.

France leads the world in aviation and all that she does is worth noting. A short time ago, in response to an inquiry by the Minister of War, over 3000 officers signified their desire to learn aerial navigation. Germany leads in aerostation, but is making great progress in aviation also. France has eight dirigibles, Germany thirty. The number of aeroplanes actually possessed by each is a rapidly increasing quantity, but France will probably possess about 350 before the end of the year, the ultimate aim being to possess 1000 as soon as the requisite number of pilots can be taught to use them.

The following statement, while it does not include all large sums that are being spent, will suffice to compare our own activity with that of some of the principal powers:

	Government appropriation	Popular subscription	Total
France	$6,400,000	$1,000,000	$7,400,000
Germany	1,500,000	750,000	2,250,000
Russia	5,000,000	(?)	5,000,000
Great Britain	2,100,000	(?)	2,100,000
Italy	2,000,000	100,000	2,100,000
Japan	600,000	(?)	600,000
United States	140,000	....	140,000

As Italy is the first to have had extensive experience with aircraft in actual war so far, some observations on her establishment and her experience will be of special interest.

In 1911 there were no public or private aeroplane factories of any importance in Italy, but this year the Aeronautic League has been formed, privately, to present to the government as many aeroplanes as possible. Funds have thus been raised to donate 100 aeroplanes, and now there are about 10 factories expecting to profit by this popular interest in the military use of aeroplanes.

There are now four squads of aviators serving in Tripoli and Cyrenaica, with 40 aeroplanes, mostly of French make, and there are 30 more in Italy.

These aeroplanes have been effectively used in scouting and they were the first to practice bomb throwing. Bomb throwing from Italian aeroplanes has been abandoned in Tripoli, however, because of its inaccuracy, and the inability to carry a sufficient number of the size required, and the attendant risk to the aviator. The Italian aviators prefer to fly without passengers. It is probable that the Italian machines, being hastily purchased, were not weight carriers, and did not have much range between high and low speeds,

For bomb dropping the dirigibles have proved greatly superior. The captains of all dirigibles are naval officers, and the semi-rigid type is now preferred.

Under the existing conditions in Tripoli, and with no enemy in the air, and hangars available on shore, the net results have been all in favor of dirigibles for observation purposes, for taking photographs and for dropping bombs.

Bombs have dropped with good effect over Turkish camps, and good bombs have been supplied which can be timed to burst in air, as well as others which are incendiary. An apparatus has been devised by which bombs can be thrown horizontally as well as with a certain angle of inclination.

Weather conditions being equal, the Italian dirigibles, which, owing to their reversible propellers, are able to remain stationary in air, can furnish more reliable reports than aeroplanes.

The aeroplane as used at Tripoli cannot fly at night when the best weather conditions obtain; the dirigible prefers to do so, as it then loses no gas.

Aeroplanes are found to be quite safe from musketry fire at

3000 feet height. They have been hit on several occasions at lower altitudes, but without serious damage resulting.

The best aeroplane flights have been from Tripoli to Gharian and back, about 90 miles each way, and to Homs and back, 70 miles each way. The aeroplanes used can easily reconnoiter at 100 km. (62¼ miles) per hour.

The best dirigible flight was from Tripoli to Sidi Sidi and back, a distance of about 125 km. (77.6 miles), during which two of the small type left Tripoli in the early morning and explored all the coast, including the Turko-Arab positions at Zuara, where they dropped bombs effectively, the whole time being 9 hours 55 minutes. Off Zuara they replenished their fuel tanks from the boats of the fleet at sea.

LATE NOTE.—The latest German dirigible recently made a flight of 1200 miles, but it is much larger than those used by the Italians.

On one occasion one of the dirigibles was struck a number of times in the after part by rifle bullets (volley fire), and returned to the hangar down by the stern.

Messages have been dropped from dirigibles in small sand bags with parachutes to which colored pennants were attached, and communication by flag or semaphore has been used, but wireless has not been used on account of the danger and incomplete development.

The Italian doctors claim that aeroplane pilots, of the machines used in Tripoli, will last effectually but six months, after which they require two years of rest, but that the dirigible pilots last indefinitely.

This result will be modified by the introduction of automatic control, mentioned later.

FOREIGN NAVAL AVIATION.

Italy.—Last year 15 naval officers were detailed for aeronautical service, at which time six Farman, three Bleriot, one Nieuport and one Etrich machine were available.

Two hydroaeroplanes, original designs by Italian naval officers, have been building for some time at the naval dock yard, Spezzia, and at Bracciano, the chief aeronautic station.

France.—In February of this year, a foreign periodical, referring to the purchase of a Curtiss hydroaeroplane by Paulhan, the French aviator, made the following statement:

It is probable that the American Curtiss hydroaeroplane will soon find its way in large quantities into the French Navy, which at present owns officially one aeroplane only, an old pattern Maurice Farman.

I am not sure that this was authentic, but I have noted in the French press frequent expression of regret that they had allowed the Americans to precede them in the naval development of aviation However, since then they have made up for lost time by providing a systematic organization, and the appropriation of ample funds for naval aviation. Their establishment includes a naval aviation center on the coast of Frejus, about half way between Toulon nd Nice.

The cruiser *Foudre,* formerly used as a mine ship, has been fitted out as an aviation ship, located at Frejus. The first hydroaeroplane accepted, a Voisin, has been hoisted in and out in three minutes. The *Foudre* does not permit of housing machines in sufficient numbers, and hangars are erected on shore to accomodate other machines that have been acquired.

During the recent maneuvers of the French fleet in the Gulf of Juan, near Frejus, where one squadron was blockaded by another, the commanding officer of the *Foudre* visited the flagship of the blockaded forces in a torpedo destroyer, and informed the admiral that one of his aeroplanes, during a reconnaisance of the Gulf, had obtained exact information concerning the disposition and movements of the blockading squadrons. Submarines had been observed navigating on the surface with evident intention of attacking the blockading force. At no time had the blockading squadron, located 15 miles off shore, perceived or heard the aeroplanes. One Nieuport (100 h. p.), three place, monoplane, one Farman and one Voisin biplane were used.

England.—Last year public indignation was aroused in England because a few naval officers had been obliged to learn the art of flying entirely on their own responsibility, and at their own expense, and because the first naval aeroplanes, two Valkyrie machines have been privately donated by a public spirited citizen.

On January 11, 1912, Acting Commander C. R. Samson, R. N., made the first flight from an English battleship over a rail platform erected over the bows of H. B. M. S. *Africa,* in much the same manner as Eugene Ely flew from the U. S. S. *Birmingham,* and the U. S. S. *Pennsylvania* in 1910.

An official reply to a query in Parliament, noted March 6, 1912, concerning England's preparedness in naval aviation, follows:

> One hydroaeroplane is now under construction at Eastchurch and two others are on order. Experiments with this type are being continued at Sheerness, Lake Windemere and Barrow.

The Royal Flying Corps has been established, and the naval wing of this corps has its headquarters at the Naval Flying School at Eastchurch. The memorandum to Parliament states:

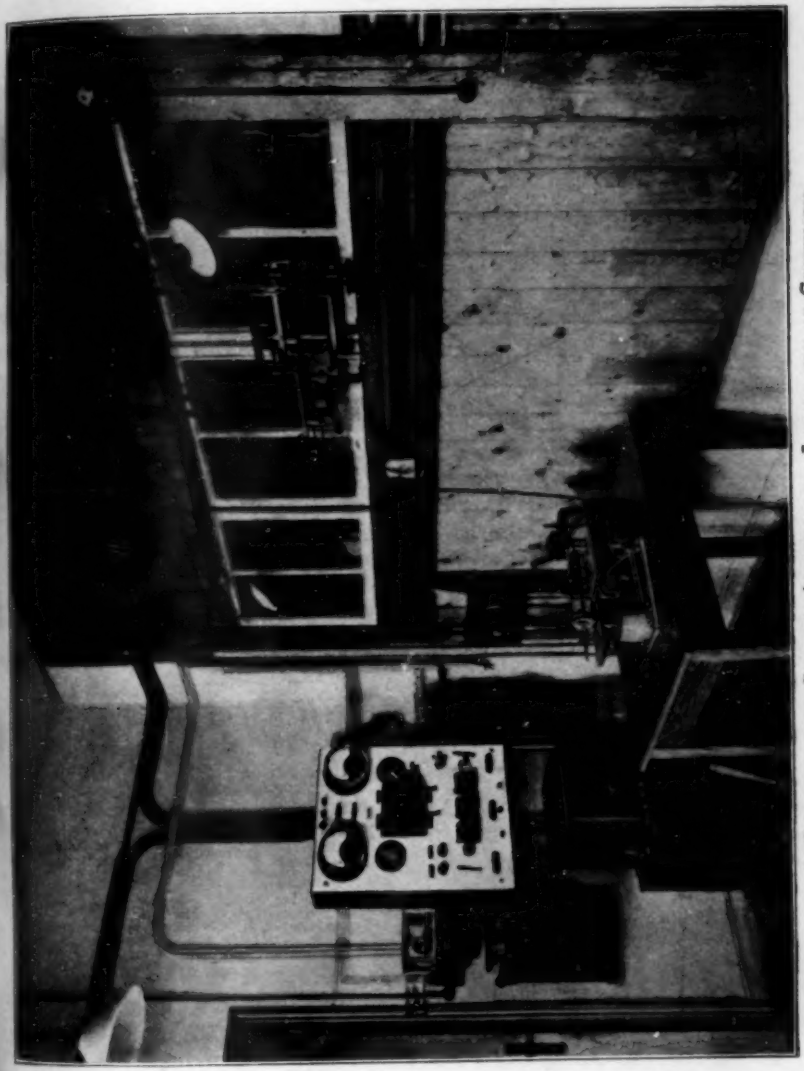
> It is impossible to forecast what its ultimate organization will be, as this depends to a great extent upon the results of experiments which are about to be commenced with hydroaeroplanes. The present organization must, therefore, be regarded as provisional.

Germany.—It is significant of German foresight that one of the first steps undertaken, when it was decided to construct a large aeroplane fleet, was to found an aerodynamic laboratory. This is at Gottingen, where the best known course of instruction in aeronautics is ably conducted by Professor Prandtl.

The Berlin Aero Exposition of this year showed a surprising development in domestic aeroplane progress. There were 176 exhibitors. Twenty-two aeroplane firms were represented by 40 aeroplanes of which not more than three were freaks, and three showed defective construction. There were 18 motor firms represented by 41 different types of motors, 41 firms for accessories, 5 tool firms and 6 steel firms.

Several German naval officers have perfected themselves in aviation, and several types of machines have been used for naval work, of both foreign and domestic make. Our Curtiss hydroaeroplane has been procured.

A competitive test for hydroaeroplanes, arranged jointly by the German Flying League, and the Imperial Navy Office, took place at Heiligendamm, from August 29 to September 5. Competitors were required to be German subjects, and every part of the machines competing, except the motor, was made in Germany. Competitors were required, after ascent from a given spot on land, to remain in the air for one hour, to alight on the water within a square of 150 meter sides, marked by buoys, to stop the motor and, after resting on the water for not more than 20 minutes, reascend to a height of 500 meters and return to the starting place entirely unassisted.



A CORNER IN THE GERMAN AERODYNAMIC LABORATORY AT GOTTINGEN.

It is astonishing to learn how nearly the characteristics required of the machines in this competition correspond to our own "requirements," independently conceived.

These machines must have sufficient inherent stability to resist sudden squalls and must be so readily guided that the pilot will not be exhausted by the longest flight.

When the motor stops in air the machine must commence to glide automatically.

The gas throttle and all levers for regulation of motor must be large and substantial and situated on the right of the pilot's seat, about 20 inches in advance of the back of the seat.

Seats arranged for two persons must be arranged so that clear view forward, each side and downward is provided for both occupants and the latter must be protected from the draft of air. Elastic leather belts 3 inches wide must be attached to each seat and arranged to be cast adrift quickly by either the right or the left hand.

It must be possible to control from both seats and the pilot must be able to cut off the control from the passenger seat.

The motor and the pilot seats must be protected against the splashing of water.

The propeller must be protected against coming in contact with water by a special arrangement. Preventative measures against short circuit, in consequence of the moisture, must be provided and the machine must have a speed of at least 80 km. (49.7 miles) per hour.

LATE NOTE.—There were seven entries in this contest, only one of which succeeded entirely.

Other Countries.—Exact details are lacking of the progress in many other countries, but all progressive powers are bent on keeping abreast of the times, especially the British Colonies, Russia, Japan and Austria. The latter country has produced one of the very best aeroplanes in existence, the Etrich, and is also developing the hydroaeroplane.

DEVELOPMENT IN THE UNITED STATES NAVY.

When Congress appropriated $25,000 for the development of naval aviation last year, three officers had been ordered to aeroplane factories for instruction, in anticipation of three machines which were finally purchased, two Curtiss and one Wright.

At that time a land aerodrome was necessary for practice, and a hangar was accordingly built on Greenbury Point, Annapolis, Md., where a sufficient area of flat land was prepared for an aerodrome by the leveling of some trees and the partial filling of a swamp. This served its purpose until the navy machines had all

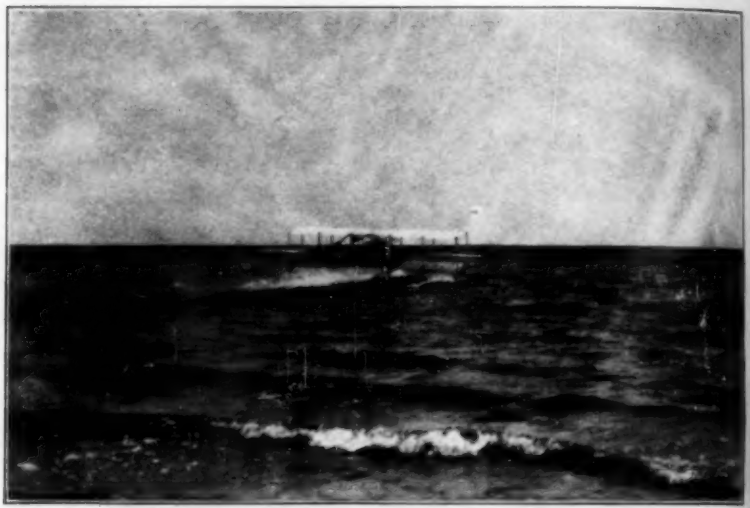
been provided with hydroplanes, and we had demonstrated the practicability of carrying on instruction entirely over water. The

THE HANGARS AT GREENBURY POINT, ANNAPOLIS.

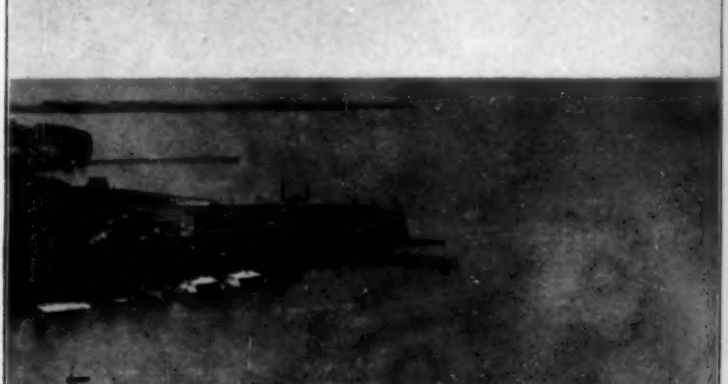
THE NAVY WRIGHT MACHINE AT ANNAPOLIS.

aerodrome is now held in reserve for the housing of spare machines, for the exercise of the land attachment of the hydro-aeroplanes and for any other emergency use.

It was originally contemplated to establish an aviation school in conjunction with the Naval Engineering Experiment Station,



THE NAVY CURTISS LEAVING FOR A FLIGHT IN CHESAPEAKE BAY.



NAVAL AVIATION CAMP AT ANNAPOLIS. GREENBURY POINT IN THE DISTANCE.
(Taken from an aeroplane.)

where experiments could be expedited, but it soon became apparent that the desired number of officers and men could not be

spared away from their regular duties for a sufficient period, and that the progress of instruction would be seriously delayed until the machines had been suitably developed and equipped for issuing to ships of the fleet, where practical instruction could proceed, with ample resources, in a systematic routine way. Incidentally, it was recognized that to get good service from these machines in the fleet, constant practice would be required, and the personnel be made as familiar with them as with other articles of equipment. This was the first object in favoring the hydroaeroplane attachment.

To-day it is recognized the world over that hydroaviation offers one of the most promising fields of development, for the reason that a water aerodrome is nearly always available, is safer in landing, is less obstructed, and the aerial currents over water are less treacherous than over land. A ship provided with aeroplanes will thus become the hangar and will be surrounded usually by an ideal aerodrome, *i. e.*, by water sufficiently smooth for practice.

Last December the three machines, with their aviators, were transferred to San Diego, Cal., where a camp was formed with small tents from the U. S. S. *Iris*, and hangar tents, of the army pattern, which had been prepared at the Mare Island Navy Yard.

Experience with these tents demonstrated certain defects, and that they were not conducive to efficient progress with a small force of men. Better tents, designed by the Bureau of Construction and Repair, have been made to replace them.

After a season of winter work at San Diego, the camp was transferred again to Annapolis, and located nearer the Engineering Experiment Station, on the north shore of the Severn River. This experience with tents has demonstrated that they not only facilitate the removal of a camp from one place to another, but that it is cheaper to use them than to provide permanent sheds of more durable material at all places where a camp may be established. The use of tents also enables us to be prepared, with the advantage of experience, to transport, at short notice, all the material that may be required at an advanced base.

INSTRUCTIONS AND TESTS.

Many officers, interested in this work, have applied for instruction, but, as before mentioned, it has not been possible to detach from their regular duties, even temporarily, all who desire the experience. Eight officers have qualified.

At the end of August, 1912, a total of 593 flights had been made by the four instruction aviators in the three machines. The record stands as follows:

IN CURTISS MACHINES.

	Flights	Total time	Distance	Passengers carried
		Hrs. Min.	*Miles*	
Lieutenant Ellyson	200	40 30	2227	111
Lieutenant Towers	202	37 2	2035	100

IN THE WRIGHT MACHINE.

Lieutenant Rodgers	132	33 54	1530	52
Ensign Herbster	59	14 54	630	9
Total	593	126 20	6422	272

During flights over water the aviator can usually count on a safe place to land. For this reason most of our hydro-flying has been done at an altitude of about 500 feet. But, as scouting and reconnaisance work will require flying at an altitude of about 3000 feet, Lieutenant Ellyson has demonstrated that there will be no difficulty in flying the hydroaeroplane at 3000 feet or over. On one occasion he ascended to 2850 feet in 23 minutes and 25 seconds. On another occasion, in testing a lower grade of gasoline, he ascended 3200 feet, but it required 44 minutes to reach the first 2500 feet. Investigation of the different grades of gasoline shows that the difference in efficiency is considerable.

The longest flight yet made with passenger anywhere, in the hydroaeroplane, is that made by Lieutenants Ellyson and Towers jointly, from Annapolis, Md., to Hampton Roads, Va., and return, and this flight amply demonstrated three things: (1) the suitability of the "hydro" as a type for long flights; (2) the practicability and utility of the dual system of control, and (3) the necessity for greater improvement in motors. The return flight was enlivened, in very cold weather, by a series of minor mishaps to the motor. In making such flights it is still advisable to follow a shore line convenient for landing in case of motor trouble.

Lieutenant J. H. Towers, U. S. Navy, has recently made a flight of 6 hours, 10 minutes and 20 seconds, with the standard navy Curtiss hydroaeroplane. This was made in due course of a regu-

lar work, but it stands as a world's record for flight in a hydro-aeroplane. A performance of five hours only would have been satisfactory.

As a part of the instruction and a fruitful means of informing us concerning necessary improvements, many repairs have been made by the aviators themselves, and the enlisted mechanics detailed for the purpose have received instruction in this way. A new Wright machine has also been built in this way from spare parts purchased from the company.

It has not been possible, under the circumstances of a meagre appropriation and few officers, combining instruction with experimental work, to establish a thoroughly satisfactory system of instruction as yet. The ideal would require each aviator student to obtain a course of study in aerodynamics and meteorology up to date, of about four months, such as that recently established at the Massachusetts Institute of Technology, the theory preceding the practical work, if possible. Such a course would be best attained by the establishment of a school for aviators in connection with the lectures at a national aerodynamic laboratory.

Experimental work.—The work of instruction has been handicapped by a practically continuous series of experiments, with the result that long delays in repairing have rendered work in both particulars slower than was anticipated. On the whole, this method of experimentation for the solution of problems other than the improvement of minor structural details and the test of navigating instruments is very unsatisfactory. Important experiments involving physical research should be relegated to an aerodynamic laboratory and its aerodrome annex. Other important experiments, such as the development of wireless, requiring frequent changes, should be made at an aircraft factory where extensive repairs and reconstruction are facilitated. Special facilities already exist for doing such work at the Washington navy yard.

Some experimental work has been done on different methods of installing the wireless plant, but intermittently, owing to the enforced absence of the expert officer whose suggestions were being followed. Although the work is unfinished, it has given promise of realizing a range of 50 miles at a sacrifice of 50 pounds only in weight.

Most of the experiments have been devoted to improving mechanical details of the motors and to trying different models of

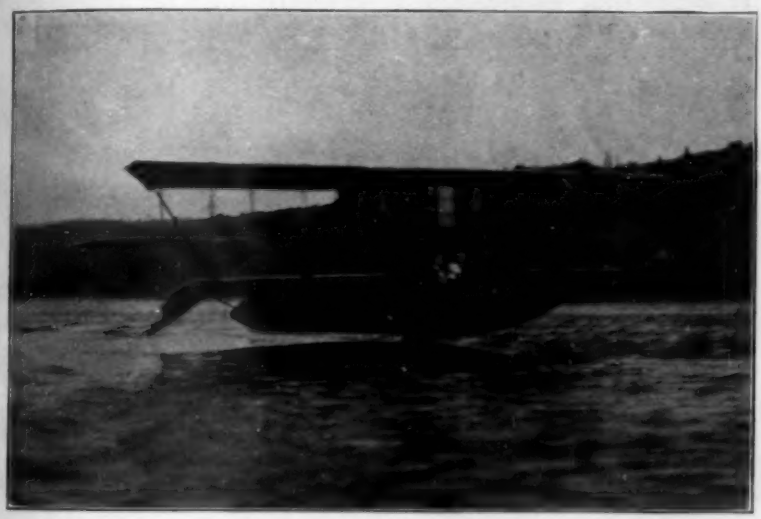
hydroplanes, the result of laboratory investigation at the Model Basin.

TWO CURTISS FLYING BOATS AND A HYDROAEROPLANE.
One boat going across the wind the other against it.

ONE CURTISS FLYING BOAT JUST LEAVING THE WATER, THE OTHER DESCENDING. THE HYDROAEROPLANE FOLLOWING.

Much useful information has been gained thus about hydroplanes, and many uncertain but alluring ideas have been eliminated.

There are seven different types of hydroaeroplanes now in France, but our efforts have been confined chiefly to two distinct American types, the single boat with balancing pontoons, and the catamaran type with two pontoons. Both types have given great satisfaction, but the single boat, which has been used on both the Wright and the Curtiss machines, seems best for our purposes. It is superior in rough water, and it is the father of the flying boat, towards which our ideas have always been inclined.

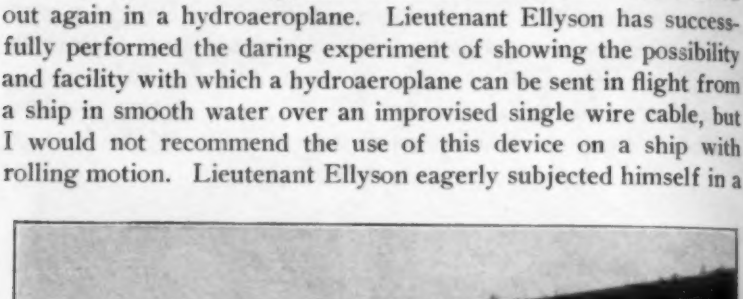


THE CURTISS FLYING BOAT.

The *Flying Boat* was discussed in the early days, about 1905, between Mr. Glenn H. Curtiss, and representatives of the Bureau of Equipment. The first real flying boat was made and tested at Hammondsport, N. Y., a year ago last summer, and flown last winter at San Diego, Cal. After several alterations in the location of the motive power, the Curtiss flying boat tested this summer, with great satisfaction, by Lieutenants Ellyson and Towers, is regarded as a decided advance in hydroaeroplane design, and gives promise of extended usefulness in rough water.

The practicability of sending aeroplanes in flight from a suitable platform on board ship was early demonstrated by Eugene Ely in flights from the U. S. S. *Birmingham* and the U. S. S. *Pennsylvania*. We have frequently demonstrated the practica-

bility of sending them in flight from water alongside of a ship, and both Mr. Glenn H. Curtiss and Lieutenant John Rodgers have flown alongside of a ship, have been hoisted on board and hoisted out again in a hydroaeroplane. Lieutenant Ellyson has successfully performed the daring experiment of showing the possibility and facility with which a hydroaeroplane can be sent in flight from a ship in smooth water over an improvised single wire cable, but I would not recommend the use of this device on a ship with rolling motion. Lieutenant Ellyson eagerly subjected himself in a



LIEUTENANT ELLYSON LEAVING A WIRE CABLE IN FLIGHT.

hydroaeroplane to the extreme shock of the first catapult device in order test the effect of such a shock, not only on the aviator but on the motor attachments and other fittings. This crucial test was entirely satisfactory in its revelations, although the aviator and the machine got a ducking, and it will probably never be required again.

There is no risk that these zealous aviators will not cheerfully undertake in the interest of adapting the art of aviation to naval purposes, and it is worthy of note that the work has progressed thus far without serious accident, although it has been ardous, dangerous and replete with temptations for the aviators to rival many of the sensational performances that have resulted disastrously to contemporary pioneers in civil aviation.

A simple and convenient self-starter is a practical necessity to the hydroaeroplane before issuing it for ship use. Several mechanical devices have been tried with varying success, but other more promising devices are about to be tried, and there is reason to believe that the very best will soon be in use on all of our machines.

The *navy aeroplane catapult* is a simple device for getting aeroplanes away from a ship in the quickest manner, and over the shortest track, the object being to avoid carrying on board ship any more paraphernalia than necessary to accomplish the object.

It has been demonstrated several times that an aeroplane can leave a ship by its own power over a suitable platform that is long enough, and can even alight on such a platform, under favorable circumstances, but it is desired to avoid the encumbrance of a platform.

The catapult is so small that it occupies little space, it can even be mounted for use on top of a turret, it can be transported to any location on the ship, and it can be readily dismounted and stowed away clear of the guns.

Compressed air is used for the power, as all ships carrying torpedoes are supplied with air compressors. When preparing the apparatus for use the air is pumped, to a suitable pressure, into a receiver which is connected with a small cylinder conveniently located on deck. The piston of the cylinder has a stroke of about 40 inches, and the piston rod is connected with a small wooden car by means of a wire rope purchase which multiplies the travel of the piston to any desired extent, or to any limit fixed by the travel of the car on its tracks.

The aeroplane, of course, rests upon the car and, when a flight takes place, both are projected from the tracks together in about 1½ seconds, the pressure being automatically and gradually accelerated throughout the stroke. The car drops into the water when free from the tracks, and is hauled on board by a rope attached to it.

The device, as used at the Washington navy yard, November 12, 1912, was mounted on a float (see Fig. 1), so that the bottom of the hydroplane was not more than two feet above the water. When discharged, the hydroaeroplane gradually arose in a steady, beautiful flight, as soon as it left the tracks, without any tendency to seek the water. (See Fig. 2, in which the car is seen just dropping clear of the hydroplane.)

During a previous trial, at Annapolis, the device was mounted rigidly on a wharf. The car and machine were both free to lift from the tracks during any part of the stroke, and after the aero-

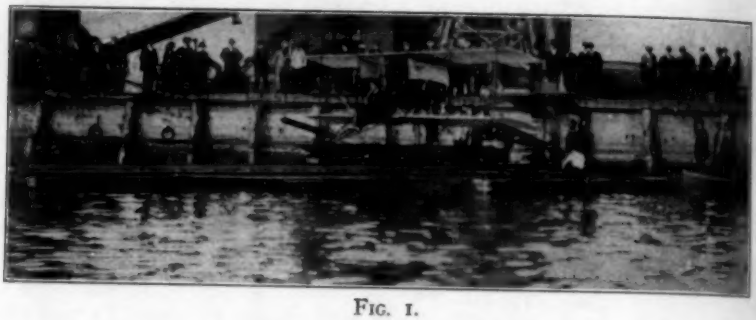


FIG. 1.

plane motor had been started full speed, the full pressure of 290 pounds was turned on at once. On this occasion the machine reared at about midstroke and, as a cross wind was blowing, the

LIEUTENANT ELLYSON LEAVING THE CATAPULT.
FIG. 2.

right wing was thrown up, and a corkscrew dive into the water resulted. Lieutenant Ellyson, the aviator who managed the

machine on both occasions, and whose iron nerves were relied on to stand the shock, was fully satisfied, by this extreme test, that the shock ought not to deter any good aviator. It was also gratifying to note that no part of the machinery or fittings was ruptured or showed any signs of weakness.

When tried at the Washington navy yard, November 12, the float enabled the apparatus to be pointed towards the wind, which, however, was nearly calm at the time. The car was held down to the tracks by reverse flanges and extra wheels, and the balanced valve of the cylinder was arranged to be gradually opened to full power by a simple wedge shaped cam attached to the travelling block on the piston head. The aeroplane was also held down to the car by an iron strap, the ends of which were tripped automatically at the end of the stroke by studs on the tracks.[1]

[1] Mr. Glenn H. Curtiss, who witnessed the test, remarked that "this device is the most important achievement since wheels were put on land machines. It is now possible and practicable to have the large ships of the Navy equipped with aeroplanes. The catapult can be readily set up on top of a turret on board a battleship and will not be in the way. It can be turned in any direction, so that the aeroplane can be shot into the teeth of the wind.

"I have never seen anything prettier in my life than the getting away of Lieutenant Ellyson this afternoon. It was perfect and really undertaken under adverse conditions, for there was not a puff of air to assist the machine in rising.

"The simplicity of the catapult makes it valuable. It can be taken down and packed in a box eight feet square. On shipboard it would be very easy to furnish compressed air, and, although yesterday a small car was used, thoroughly greased rails would do just as well.

"I came here at the request of Captain Chambers to help, if possible. Captain Chambers has given the world something that will be eagerly taken up by every navy. Foreign navies will grab this idea, and probably the ships of Germany and Great Britain now building will have an aeroplane auxiliary.

"The hydroaeroplane is giving way to the aeroboat, or flying boat. The Navy has purchased one of this type, which will be delivered in Washington probably next week. It will be launched from the catapult. If this final test is successful there is no reason why the new *Pennsylvania* cannot be equipped with an aeroplane. The solution of safely launching an aeroplane from a battleship has been solved, so why not?

"I expect to see aeroplanes installed on battleships very soon now."

Captain Chambers believes that the success of the catapult opens great possibilities for the hydroaeroplane or the aeroboat, in the Navy. The catapult is light and can be taken down and stored in comparatively small space.

Almost two years ago, in Hampton Roads, Eugene B. Ely, since killed in

Several preliminary tests of the device, with sand bags to represent the weight of the aeroplane, were made before the final test of November 12, and curves of speed and pressure were obtained in each case. These curves are reassuring and demonstrate the possibility of getting, by this method, the curve of velocity to follow any trajectory desirable within practicable limits.

Figure 3 represents the car weighted with sandbags for a test at the Navy Yard, and Figure 4 shows the car with its sandbag burden just leaving the tracks. It is interesting to note in this

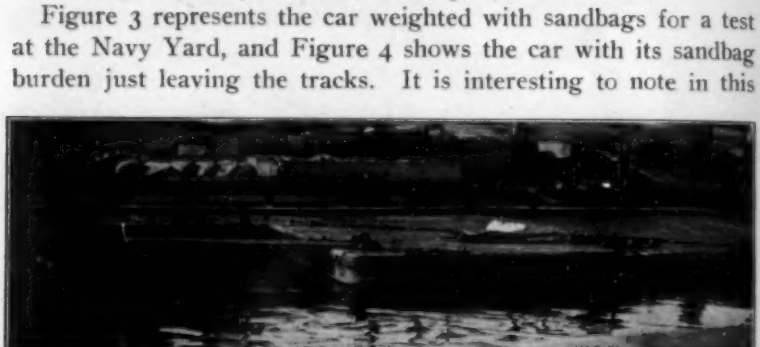


FIG. 3.

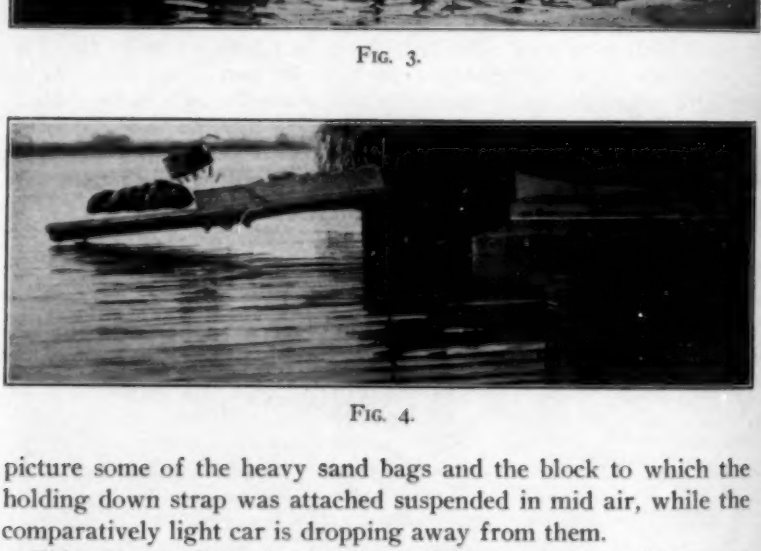


FIG. 4.

picture some of the heavy sand bags and the block to which the holding down strap was attached suspended in mid air, while the comparatively light car is dropping away from them.

This picture (Fig. 4), also shows the airflask, the cylinder, the piston rod and the cam.

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a machine, made the first flight from the deck of a vessel, rising in a biplane from the *Birmingham*. Compared with to-day's test, the method of two years ago was crude, a platform being used that occupied most of the deck space forward.

Instruments.—Aviators and manufacturers have been slow in making use of instruments which not only make flying safer, but which may be made to relieve the aviator of much of the nervous tension and strain of long flights and flying in uncertain weather. A constant increase in the number of disasters has disturbed the people of France for some time, with the result that special attention has been given to the problem of safety; special efforts have been made not only to improve inherent stability and structural strength, but to provide means for controlling the equilibrium automatically.

One cannot blame those who are already skilled in flying for being conservative in this matter, in view of the many defective devices that have been exploited to effect the object. There is a good reason for going slowly and carefully in the test of anything that presumes to take the place of the aviator's skill, but manufacturers and aviators are beginning to realize that progress in aviation is greatly dependent upon the perfection of instruments for safe guidance and automatic control, that there is something more than acrobatic skill required to place aviation on a practical footing in the navy, that the elimination of man as a factor of chief importance by the supply of mechanism which will perform the things that he is prone to do indifferently, especially under the strain of fatigue, is a practical necessity to his success as a real aerial navigator.

Simple and reliable automatic control devices which may be added without sacrifice of too much weight are now being eagerly sought, and some that may be rigged to work automatically, semi-automatically, or not at all, at the will of the aviator, are being made.

The Air Compass.—Much important work for which the aeroplane will be useful in the navy will not necessarily require the air pilot to navigate in a fog, or at night, or out of sight of his base, but in sea scouting, which I think is destined to be one of his principal spheres of usefulness, the pilot may be caught in a fog, he may be obliged to navigate at night and will have to lose sight of his base frequently. It must be possible, therefore, to navigate as accurately in air as it is to navigate a ship by dead reckoning at sea.

Motors.—Improvements have been confined principally to the correction of small defects, which have been made as soon as dis-

covered. Much more could be said about what is still needed. When anything goes wrong, or when trouble begins in a flight that promises well, some trifling detail of the motor is usually at fault, a small pin here, a pump connection there, but nearly always something new and unexpected. It was so with the early motors of automobiles, and this thought inspires confidence in the perfection of aviation motors, although the demand is still greater for increased power or speed rather than reliability and durability.

Range of Speed.—A weight carrying aeroplane such as a hydro-aeroplane necessarily needs a motor with considerable *range* of speed, and the same kind of motor is needed to reduce the danger of alighting. This is not the kind of motor and combination of motor and surfaces that now wins the speed contests such as that for the Gordon Bennett Cup. I think aviation would be improved if the terms of future speed contests were arranged so as to require each contestant to go over the course twice, the second time at an average speed 20 per cent lower than his highest average.

Requirements.—A year ago our manufacturers requested specific information as to the conditions to be satisfied in adapting the aeroplane for naval use. The answers at that time were necessarily indefinite, but with the benefit of a year's experience we have been able to issue a set of "general requirements," sufficiently broad in scope, to permit a wide latitude for ingenuity and improvement.

These requirements cover not not only the peculiar conditions to be satisfied in naval aviation, but, for the first time, require our builders to show that their machines are designed in accordance with up-to-date practice. Builders are required to prove technical data, which will eliminate from competition all who depend on haphazard methods. Complete stress diagrams under different conditions of load and all fundamental characteristics, a knowledge of which is indispensable to an intelligent comparison of designs, are demanded. The stamp of approval is given to the introduction of improved methods for the automatic control of equilibrium, and our builders are encouraged to attain a high degree of efficiency, to improve the factors which govern safety, and nothing is demanded that may not be readily accomplished under the limitations of the art as it is generally understood at present.

UNSATISFACTORY LIMITS IN APPROPRIATIONS.

In accordance with the policy of the Department, as mentioned in the last annual report of the Secretary of the Navy, aeroplanes are now placed in the same category as other articles of a ship's equipment, and are appropriated for accordingly, the general architecture and constructional features being provided by the Bureau of Construction and Repair under its general appropriation "construction and repair of vessels," and the motive power, including radio apparatus, being provided by the Bureau of Steam Engineering under the appropriation for "steam machinery," it being intended that all Bureaus will do their share in providing the specific parts which naturally come under their cognizance in the Department organization.

It seems unnecessary to place a limit on aeroplanes under these appropriations when expenditure on boats, steam steerers, windlasses, boilers and "all other auxiliaries" costing much more, is unlimited. No economy is effected by placing a limit on any one of the numerous items under these appropriations, and no extravagance can occur by removing the limits on aeroplanes because, regardless of limits, the amount of each appropriation remains the same, and expenditures on each item will be jealously guarded, by the Bureau concerned, to carry on current work as necessities arise.

It is particularly unfortunate that the small limit of $20,000 is placed on aeroplane machinery under the Bureau of Steam Engineering, because our experience shows that each aeroplane used for instruction requires two motors to carry on the work effectively. This, of course, will be impossible under the present limit, as the expense of repairs is also comparatively great. The limit of $35,000 under Construction and Repair is unsatisfactory also.

INFLUENCE OF FOREIGN LABORATORIES.

Little more than a year ago our knowledge of the effect of air currents upon aeroplane surfaces was almost entirely a matter of theory. The exact information available was so meager that aeroplanes were built either as copies, slightly modified, of other machines, or else by way of haphazard experiment. This state of affairs obtains to some extent in the United States to-day,

although in Europe aeroplane construction is now largely based on scientific data obtained at notable aerodynamic laboratories.

The intuitive, hasty and crude methods of the pioneer cannot succeed in competition with the accurate and systematic methods of the scientific engineer, and it is beginning to dawn upon our perceptions that, through lack of preparation for the work of the scientific engineer, *i. e.*, through delay in establishing an aerodynamic laboratory, a waste of time and money, a decline of prestige and an unnecessary sacrifice of human life has already resulted.

Students of aviation do not need to be informed of the practical necessity of aerodynamic laboratories. They have repeatedly

THE ST. CYR AERONAUTIC INSTITUTE.

pointed out, in aeronautical publications, the immense commercial advantages to be anticipated from the establishment of at least one in this country, and they have naturally expected that some philanthropic patriot, of wealth and scientific interest, would come to the rescue with a suitable endowment fund that would enable such work to be started in short order without government aid. The fact that no patriot has responded is disappointing, in view of the large private donations that have done so much for aviation in France, but in my opinion, it simply indicates something lacking in the manner of disseminating information concerning the importance of the subject. I am not willing to believe that our people will refuse to establish one when they are fully acquainted

with the advantages to humanity, and to sane industrial progress, and when a reasonable concrete proposition is advanced for their consideration. I have submitted such a proposition which follows, in general outline, the ideas advanced in an address to the Fifth International Aeronautic Congress by one of the greatest authorities in the world, the Commandant Paul Renard, President of the International Aeronautic Commission.

A NATIONAL AERODYNAMIC LABORATORY.

Before considering the character of the work to be done, and some details of the needed plant, it will facilitate matters to show what should *not* be done at such a laboratory.

There are those who dream of supplying the laboratory with all the instruments known to mechanics, to physics, and even to chemistry, in order to have a creditable and complete national institution. They would concentrate in one locality all the scientific instruments and acumen available with the false idea that economy would result. This would be a grave error.

The financial resources, however great, are sure to be limited, and a too ambitious or a superfluous installation would squander the sources of power and indirectly menace the initiative of other industries. The character of the new work to be done demands that everything should be rejected that can be dispensed with readily, in order that appliances specially needed in the new work may be provided, and that these appliances be of the latest and most efficient types.

For the sake of economy, not only of money but of time and intellectual energy, tests and experiments that can be executed as well or better elsewhere by existing establishments, should be avoided. For example, it is unnecessary to install a complete set of instruments and implements for testing the tensile strength of materials or their bending and crushing strength. Many other establishments permit of such work. If the laboratory be located in Washington, where certain advantages exist, such work could be readily done at the navy yard, where other facilities exist, such, for instance, as the testing of models for hydroaeroplanes, and flying boats. The Bureau of Standards and Measures, and other government branches in Washington, also offer facilities which it would not be wise to *duplicate* in such a laboratory.

I do not think that such an institution should be burdened with measuring the power of motors, or preoccupied with the details of their performances. This may be done at various other government establishments, and it is understood that the Automobile Club of America is also equipped for this work.

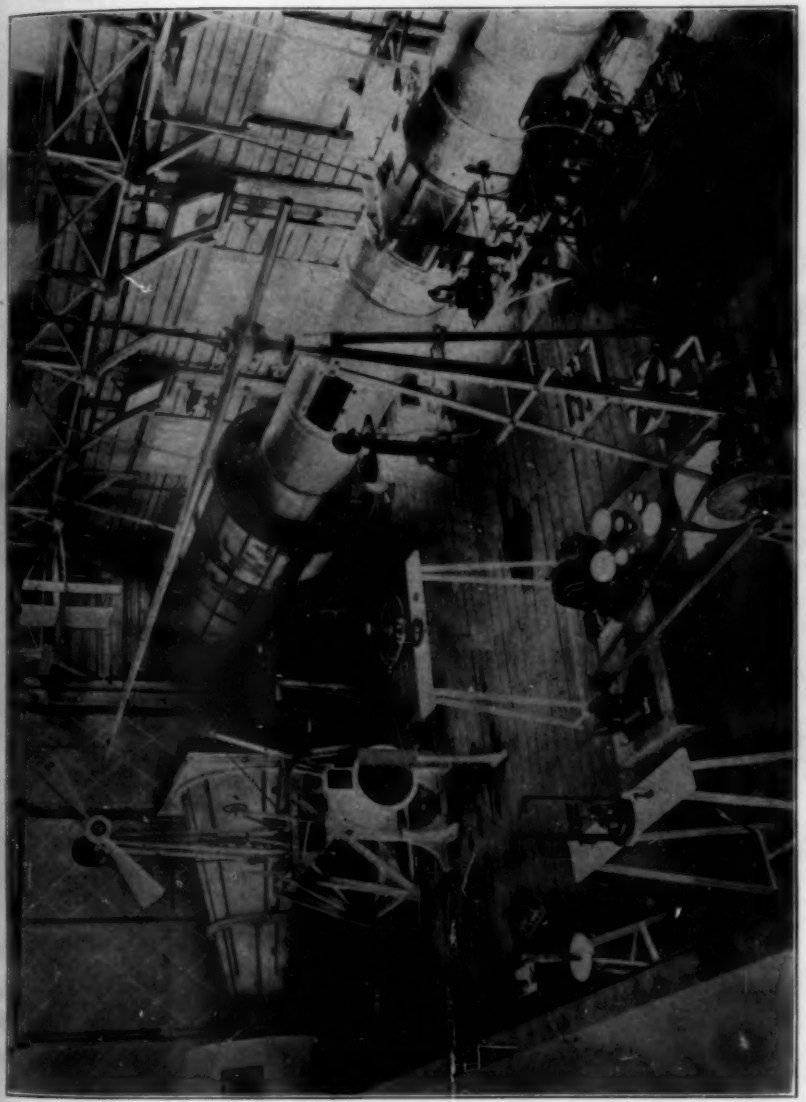
Nor is it necessary to have a complete chemical laboratory under the pretext of studying questions relating to the chemistry of fuel, or the permeability of balloon envelopes.

I do not wish to convey the idea that an aerodynamic laboratory should be deprived entirely of such facilities, and that it should be obliged to seek minor information from other establishments when that information may be more economically obtained by a duplicate plant on a small scale. Such duplicate conveniences, however, should be regarded as strictly accessory, but it should be well understood that, whenever important researches can be prosecuted as well or better elsewhere, dependence should be placed on those other establishments where such work is a specialty.

TWO DISTINCT CLASSES OF WORK.

An aerodynamic laboratory should be devoted to (1) experimental verification; (2) experimental research. The first is concerned with testing the qualities of existing appliances, propellers, sustaining surfaces, control mechanism, etc. Usually these tests are made at the request of interested parties (as is now the case with the water models at the navy yard model basin). A constructor or designer will bring, for example, a propeller, and will wish to know its power or thrust at a given speed on the block, or on a moving appliance under the conditions of flight, or he may bring several propellers to compare their performances and to ascertain what power they absorb at different speeds.

One of the very successful appliances devoted to this work at St. Cyr is a movable car in which an aeroplane may be mounted and tested at speeds, in perfect safety, as to its strength, its efficiency, and the suitability of its control mechanism. This device is specially adapted to make actual service tests of sustaining surfaces—in other words, to try out, in perfect safety, the relative efficiencies of finished aeroplanes. It is a most important adjunct, as it supplements and rounds out the important research work on models in the closed laboratory.



Interior of Russian Aerodynamic Laboratory at Koutchino.

Tests of this character, *i. e.*, verification tests, constitute, so to speak, standard work. They are performed at the request of manufacturers, clubs, independent investigators, and other interested parties on condition of payment for the actual cost of the work. They, therefore, contribute to the support of the establishment.

The tests of verification, however, notwithstanding their great utility, do not constitute either the most important or the most interesting work of the laboratory. The *research work*, which prosecutes continuously and patiently systematic, thorough and

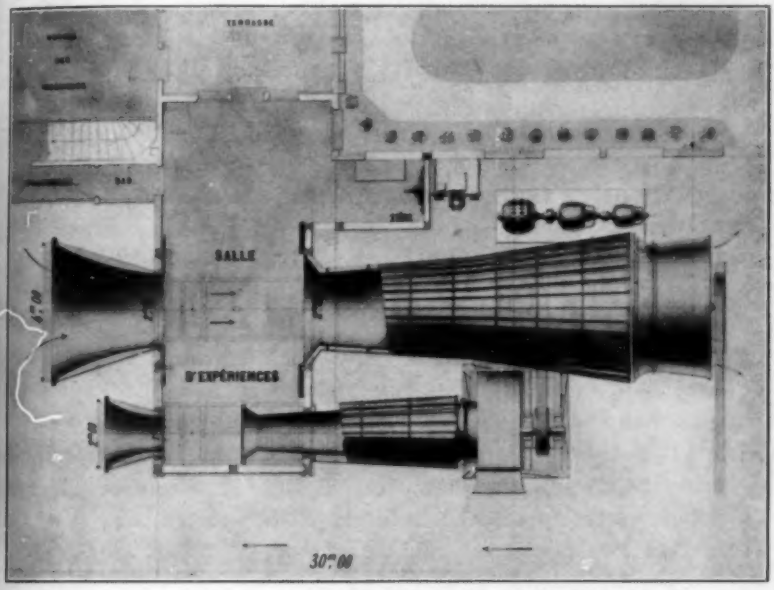
THE ROLLING TRUCK TESTS AT ST. CYR.

precise investigation of new ideas, or of old ideas with new applications, with the specific intention of discovering laws and formulae for advancing progress of aerial navigation, is of greater importance, because it is the short cut to substantial efficiency, economy, improvement and prestige.

This work is concerned with developing adequate methods of research in all branches of aerial navigation, and in furnishing reliable information to all students, engineers, inventors, manufacturers, pilots, navigators, strategists and statesmen. The knowledge thus gained should be disseminated regularly through publications, lectures, open-air demonstrations, and by exhibitions

of apparatus, instruments, materials and models—in fact, by all the facilities of the aerodrome, the showroom, the library and the lecture room.

An exact knowledge of aerodynamics can be best acquired in such a laboratory by experimentation with standard scale models in air tunnels, such as those used by M. Eiffel, and others. In this way reliable data is obtained of the air resistance to be encountered, and the efficiency at various velocities, the amount of



PLAN OF PORTION OF EIFFEL LABORATORY.

lift, the effect of varying impact at different angles of attack on the stability, in fact all the exact data which, reduced to curves and diagrams, enables the engineer to design a machine in a scientific manner. From such data the performance of a new machine can be closely predicated. The performance of the finished product can be verified, later, as before described.

Much of the research work will be prosecuted at the request of technical men outside of the institution to whom the laboratory should offer, gratuitously as far as possible, its material and personal resources.

THE COUNCIL AND ORGANIZATION.

To obtain benefit from these researches it will be necessary to know that they are worth the time and expense, and a body of men —a *council* or a *board of governors*—should be authorized to accept or reject requests for this work. This will be a delicate task, but the principal duty of the council should be to establish and to correct, from time to time, a program of the research work to be executed by the *director* and *his staff*, and to co-ordinate the work to the best advantages within the limits of the money available. The disbursement of the government funds, however, and the responsibility therefor should be entirely under the director.

With the actual state of aerial navigation and its deficiencies as a guide, it will be the policy of the council to concentrate effort upon such points as seem most important, promising and interesting for the time being.

I do not think there would be any doubt, if we had the laboratory in working order now, but that all questions relating to improvement in stability, automatic control, and safety in general would have the right of way.

The council or board, which in England is called the "advisory committee," should be representative of other government departments than that employing the director, and should be independent of the director and his administrative staff. It might be possible for the director to act as a member of the council, and if so, it would conduce to harmony and expedition.

The council should not be a large body, but should be composed mostly of specialists of unquestioned ability, men interested in the sane development of aerial navigation in various branches of the government, and in its useful and safe adaptation to commerce and sport.

Whatever the ability of this council, it should not be allowed to pretend that it has a monopoly of aeronautic acumen. Many brilliant and worthy ideas may originate outside of the establishment which it will be wise to investigate. And to avoid any possibility of the council being charged with narrow prejudice, it is indispensible that it be not composed entirely of specialists. In a few words, it should comprise representative men, who are also learned and technical men, with broad vision and reputation, whose

presence will guarantee to industrial investigators that their ideas will be treated in an unpartisan or unbiased spirit. I will not attempt to suggest the composition of this council or board, but it is evident that the army and the navy should each be adequately represented on it.

ENDOWMENTS, PRIZES, AND REWARDS.

If the laboratory should obtain, in addition to the funds required for prosecuting researches by its staff, any endowments of financial aid in excess of immediate needs (and I am confident it will eventually), it would accomplish useful work by offering prizes and granting rewards for important results achieved outside of the institution. The division of rewards would be one of the functions of the council, and it is possible that this would be one of the best uses of such resources, after the success of the laboratory is assured.

The *complete rôle* of an ideal aerodynamic laboratory can be summed up now in a few words in the natural order of establishment: (1) Execution of verification tests by means of nominal fees; (2) Facilities to technical men for prosecuting original researches; (3) Execution of researches in accordance with a program arranged by the council; and (4) Reward of commendable results accomplished outside of the laboratory.

NATURE OF THE PLANT.

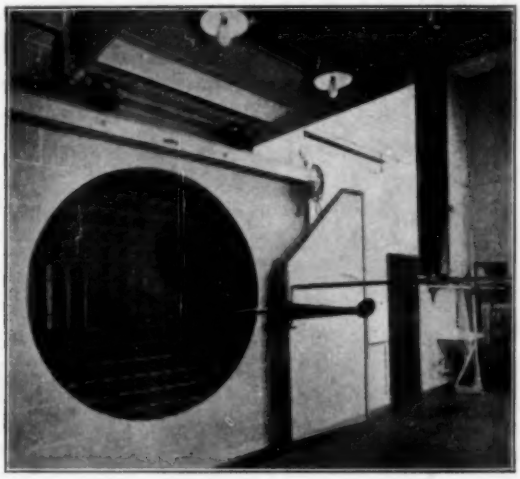
Researches and tests can be made on either a large or a small scale, preferably on both.

The use of small models can be made prolific in results because of the comparatively small cost, provided we understand the laws governing transformation into the full sized products. For model work a large plant is unnecessary. M. Eiffel has done very valuable work in a very small establishment.

Certain classes of tests with large models, such for example as the block test of propellers, do not require much space. But the conditions are altered when such tests are made on a machine in motion. These more difficult tests are absolutely indispensable, and very important to the usefulness of an official laboratory.

Experiments and tests with small models being comparatively inexpensive, private establishments often undertake their execu-

tion, but when we attempt to draw conclusions from their results, we are obliged to admit that the laws of comparison with full-sized machines are debatable the world over. Comparisons are sensibly true between small surfaces and larger surfaces that have been extended proportionately to the square of the linear dimensions, even to surfaces five or ten times larger, but when we pass to much larger surfaces, as we are obliged to, we are forced to adopt formulae with empirical coefficients about which there is indefinite dispute.



A MODEL NIEUPORT MONOPLANE.

The difficulty can be overcome only by precise experiments upon large surfaces, and such experiments, whatever the manner in which they are performed, will be costly. If privately executed, the financial returns would not cover the cost.

The laboratory should comprise, therefore, two distinct parts, one devoted to experiments on small scale models, and the other to experiments on surfaces of large dimensions. But in both parts precise and thorough work is necessary.

When we have studied separately each element, of an aeroplane, for example, it will be necessary to test the complete apparatus. An aerodrome annex is, therefore, necessary, or, at least, the

laboratory should be located in proximity to an aerodrome of which it can make use. In order that the observations may not only be qualitative but quantitative, it will be necessary to follow all the movements of the complete machine, to know at each instant the speed, the inclination, the thrust of the propellers, the effective horsepower, and , in fact, to conduct a true open air laboratory for

TESTING THE CURTISS HYDROAEROPLANE MODEL AT THE MODEL BASIN, NAVY YARD, WASHINGTON, D. C.

aircraft, after the manner of certain tests that have been prolific of results in France.

The English have established close relations between the Royal Aircraft Factory and their laboratory, the function of the former being that of the reconstruction and repair of aeroplanes, the test of motors, and the instruction of mechanics.

LOCATION OF THE LABORATORY.

The location of the model testing plant, the headquarters of the administration staff, requires comparatively small space, and there is no reason why it should be remote from a city, or from intellectual and material resources. It is advantageous to have it easy of access to many interested people who are not attached to it.

The location of the open-air laboratory should obviously be at an aerodrome, as near as may be convenient to the model testing plant or headquarters. Close proximity of the two parts is desirable but not necessary. The high price of land near a large city obliges the aerodrome annex of foreign plants to be located at a distance, but we are fortunate in having here, at Washington, ideal conditions for the location of both barts. The model laboratory should obviously be located on the site of Langley's notable work at the Smithsonian Institution where the nucleus, an extensive library of records, and certain collection of instruments are still available. The National Museum is also an ideal location for the historical collection of models that will result.

No more ideal location for the annex, the open-air laboratory or aerodrome, exists in all the world than that afforded by the, as yet undeveloped, extension of Potomac Park. This is government property, which is of doubtful utility as a park only, but which would be of immense utility and interest as a park combined with a scientific plant of the character under consideration.

There is no reason why the public should be excluded from such a practice field, but there is much to recommend that it be open to the public under proper regulations as to the traffic, especially on occasion of certain tests or flights of an educational value. It is of sufficient area, about one square mile. It is about two miles long, is almost entirely surrounded by broad expanses of water, and while convenient of access, is so situated that the public may be readily excluded when tests of a dangerous character are in process of execution. The fine driveways that will be required as a park will offer excellent facilities for the practice work of the aerodrome and for the moving test cars that should be supplied.

One of the most attractive features of this location is the advantage it offers as an ideal aerodrome for both the army and the navy, for both land and water flying, and the opportunity it affords

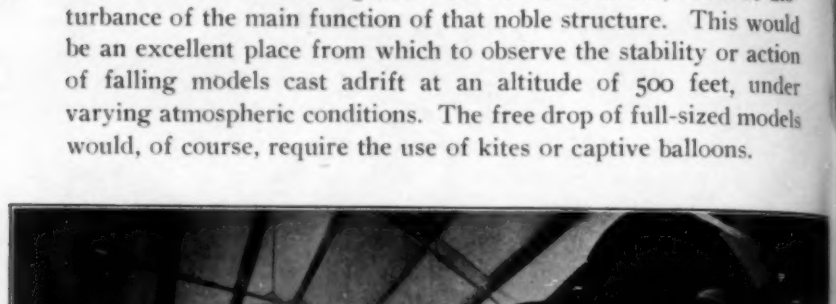
for co-operation in all branches of the work of instruction and experimentation. Furthermore, it is near to the shop facilities of the navy yard, the accommodations of the Washington Barracks, the conveniences of the various government hospitals, and it would doubtless add to the information and interest of the nearby War College Staff and the General Board of the Navy. Its location would enable our statesmen in Congress, and a great number of the officials in all departments to keep in touch at first hand with the progress of aeronautics, with the quality of the work done, and with the manner in which the money appropriated was being expended. The educational facilities offered by the work and by the lectures would be invaluable to the course of instruction for army, navy and civil students of aeronautics.

As Washington is a mecca for business people of all parts of the country, a laboratory located here would be convenient in a commercial sense, especially in view of its southerly location, which renders the open aerodrome available for use throughout the greater part of the year. The only objection that I can see to the Potomac Park extension is that the ground will require a considerable clearing, but the trees on the harbor site of the location would not necessarily require removal.

THE APPARATUS NEEDED.

It is useless to discuss here the various instruments and methods which have been subjects of some dispute abroad. All have some good feature, but time has shown where some of the cumbersome and unnecessary installations may be eliminated to advantage and where others may be improved. The new plant of M. Eiffel, at Anteuil, may be regarded as a model for the wind tunnel and the aerodynamic balance. A duplicate of that plant alone would be of inestimable value. The last volume published by M. Eiffel is a forcible example of the value of his discoveries, by this method, with respect to the angle of incidence and the displacements of the center of pressure. It seems to merit the utmost confidence, although the details of his installation differ from those at Chalais, at Koutchino, at the Italian laboratory, and others. This method permits of testing the resistance of body structures, the sustaining power of surfaces, the tractive power of propellers, and the influence of transverse or oblique currents. If a "free drop" apparatus at uniform speed be regarded as indispensable to obtain-

ing the coefficients of air resistance to solid bodies of different shapes, it is possible that the interior of the Washington Monument could be used to advantage, as was the Eiffel tower, without disturbance of the main function of that noble structure. This would be an excellent place from which to observe the stability or action of falling models cast adrift at an altitude of 500 feet, under varying atmospheric conditions. The free drop of full-sized models would, of course, require the use of kites or captive balloons.



THE SUCTION BLOWER AT THE END OF THE WIND TUNNEL.
(In the new laboratory of M. Eiffel at Anteuil.)

The moving car, previously referred to for tests of verification, would be the most useful open-air plant and would soon repay the outlay required by the value of the information obtained from its use. A miniature duplicate of this method for preliminary tests on models with a wire trolley would be of value in a hall of large dimensions. It would be useful in winter work, but not invaluable.

The track of the open-air vehicle at St. Cyr is too restricted to give the best results. The car cannot circulate continuously at high

speed and maintain the speed for a sufficient length of time. An ideal endless track may readily be arranged at the Potomac Park extension, preferably of rectangular form with rounded corners. A railway track would be preferable, but excellent results could be obtained from autotrucks run on macadamized road-beds. Good results could be obtained by the use of suitable hydroaeroplanes or flying boats suitably equipped with instruments.

At the aerodrome annex ample facilities should be provided for measuring the wind velocity at various heights and at different points. The convenient installation of recording anemometers and the employment of kites or captive balloons should be considered.

A branch of the U. S. Weather Bureau could readily be established at the aerodrome here in connection with the investigation of meteorological phenomena affecting the movements of aeroplanes in flight, and as an adjunct to the national laboratory.

Exactly measured bases and posts of observation are also required, as well as instruments of vision or photographic apparatus, to permit of following machines in their flights and of preserving the records for study.

One of the most useful installations for recording advanced information is an actual aeroplane itself equipped with instruments adapted to record, while in flight, much of the information that is desired. Such a machine is already in use in France and in England.

It will be in perfect harmony and convenient to the laboratory to obtain all the services of an aircraft factory for the Washington navy yard, where facilities already exist for the reconstruction and repair of aeroplanes, the test of motors, and the instruction of mechanics. But this should not be allowed to interfere with our policy of relying upon private industry for the purchase of new machines for the sake of encouraging the art among private builders.

It will suffice to merely mention the hangers or sheds required, or the local accessories, such as drafting rooms, offices, and minor repair shops. The character and location of these present no difficulties, but they should not be made the principal part of the institution as they are in several elaborately equipped foreign laboratories. The power plant, however, is a subject for careful consideration, and the economy effected by M. Eiffel in his new installation at Anteuil is worthy of study.

COST.

I have seen estimates varying from $250,000 to $500,000 for such a plant, but inasmuch as $100,000, with an annuity of $3000, donated by M. Henry Deutsch de la Meurthe, to the University of Paris, for the establishment of the aeronautical laboratory at St. Cyr, seems to have been sufficient for a very creditable though somewhat deficient plant, I will venture an opinion that $200,000 would be sufficient in our case. Although the same plant would cost more in this country, I assume that some of the buildings required are already available at the Smithsonian Institution. If located elsewhere, the cost would be considerably more than the sum named.

A COMMISSION RECOMMENDED.

Inasmuch as more definite information regarding the actual cost of a dignified and creditable, but modest and sufficient installation should be obtained, and as the details of the plan, the scope, the organization and the location of such an important undertaking should not be left to the recommendations of one man, a commission or board should be appointed to consider and report to the President, for recommendation to Congress, on the necessity or desirability for the establishment of a national aerodynamic laboratory and on its scope, its organization, the most suitable location for it, and the cost of its installation.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

STAR IDENTIFICATION.*

By CAPTAIN HARRY S. KNAPP, U. S. Navy.

Hydrographic Office publication No. 1560, listed in Portfolio No. 1 of every station chart catalogue under the title Diagram for the Graphical Solution of Triangles, though its real title is Graphical Method* for Navigators, by Commander (now Rear-Admiral, retired) C. D. Sigsbee, U. S. Navy, has proved so useful to me for one particular purpose that I venture to invite the attention of the service to it. If any excuse is needed, it may be found in the fact that I have not yet run across anybody in the service who had used the diagram for the particular end in view until after I had spoken of it.

Every navigator who employs twilight sights appreciates any method by which a star or planet can be unhesitatingly identified, whatever the conditions of cloudiness or light. This is particularly the case at evening twilight, when the brightest stars may often be detected in broad daylight while the horizon is excellent, though the lesser stars of the constellations are still invisible. The identification can be made by waiting, if cloudiness does not intervene; or, with a loss of time, by other known methods, if the azimuth is made a part of the observation. A few minutes' work *beforehand* with the Sigsbee Diagram will enable the navigator to identify his star at once on sight; more than that, it will enable him to look for his star early in exactly the right place. I have myself frequently set my sextant and found a star by sweeping

*Navigators interested in graphical methods are also referred to an article in the PROCEEDINGS of Dec. 1908, No. 128, entitled "The Azimuth Diagram and Its Availability for the Solution of Various Problems in Navigation," and to the use of "The Azimuth Diagrams," of Captain Weir, which diagrams are found in all chart outfits.

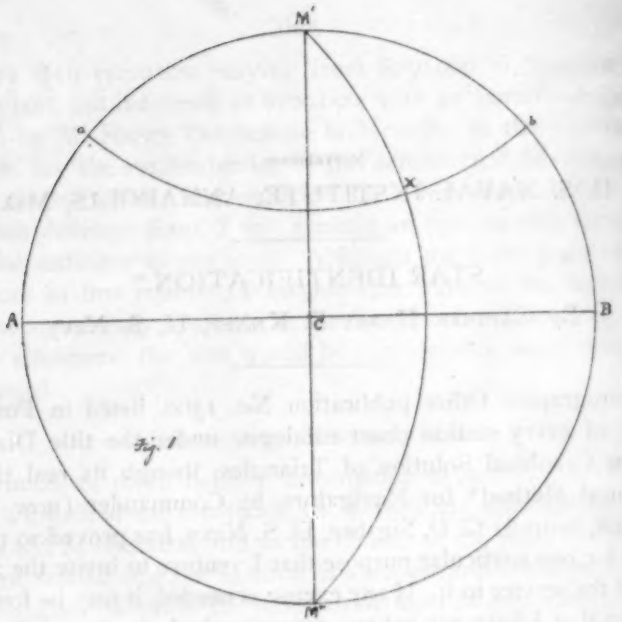


Fig. 1

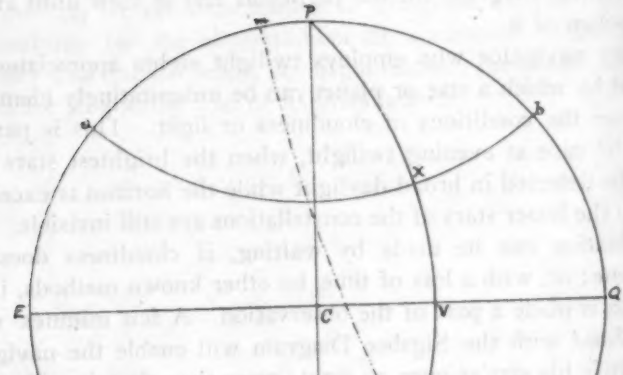


Fig. 2

when the star was invisible in the sky, and I have seen others do the same thing.

The Sigsbee Diagram is a stereographic projection, on the plane of the meridian, of (a) the great circles traced by planes all passing through a common axis, which is also one axis of the meridian, and of (b) the one great circle and (c) the small circles traced by planes at right angles to this common axis. In Fig. 1, which is an incomplete diagram, the primitive, or bounding circle, $M'BM''A$ is the celestial meridian, $M'XM''$ is one of (a) the

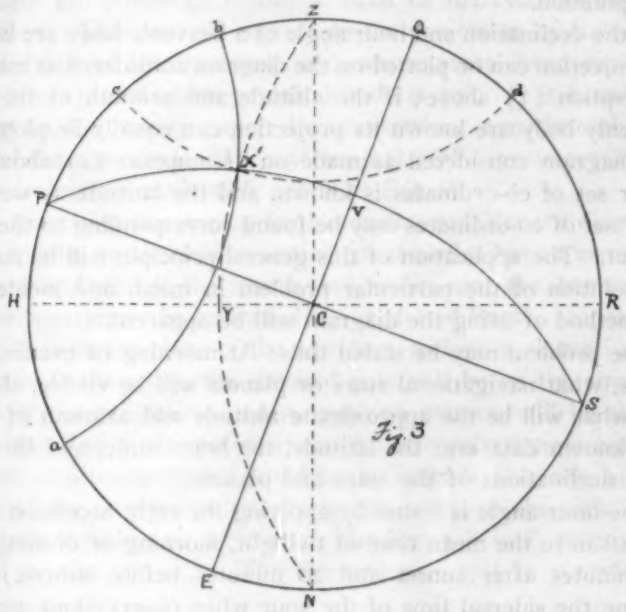


Fig. 3

great circles passing through the common axis $M'M''$, ACB is (b) the one great circle, and aXb is one of (c) the small circles traced by planes at right angles to the common axis $M'M''$. In the complete diagram, the great circles through the axis and the small circles at right angles to it are all drawn at intervals of one degree where the diagram permits it without undue crowding of lines. If (1) the common axis passes through the poles, the first (a) are hour circles (meridians), the second (b) is the equator, and the third (c) are declination or latitude circles. Thus in Fig. 2, in which the full lines are exactly the same as in Fig. 1, but with

different lettering, P is the elevated pole, S the depressed pole, PXS is an hour circle, EQ is the equator, and aXb is a circle of declination. If (2) the common axis passes through the zenith and nadir, the first (a) are azimuth circles, the second (b) is the horizon, and the third (c) are altitude circles. Thus in Fig. 3, Z is the zenith, N the nadir, and of the dotted lines HR is the horizon, $ZX'N$ is an azimuth circle, and $cX'd$ is an altitude circle. To use the diagram, there are only needed a sheet of tracing paper and a pencil; the rest of the work is arithmetical, or a matter of manipulation.

If the declination and hour angle of a heavenly body are known, its projection can be plotted on the diagram considered as made on assumption (1) above; if the altitude and azimuth of the same heavenly body are known its projection can equally be plotted on the diagram considered as made on assumption (2) above. If either set of co-ordinates is known, and the latitude as well, the other set of co-ordinates may be found corresponding to the same instant. The application of this general principle will be made in the solution of the particular problem in mind, and incidentally the method of using the diagram will be apparent.

The problem may be stated thus: At morning or evening twilights, what navigational stars or planets will be visible, if clear, and what will be the approximate altitude and azimuth of each? The known data are: the latitude, the hour angle, and the tabulated declinations of the stars and planets.

The hour angle is found by applying the right ascension of the mean sun to the mean time of twilight, morning or evening (say 20 minutes after sunset and 20 minutes before sunrise), thus getting the sidereal time of the hour when observations can suitably be taken. It is not necessary to work closely for the purpose in view, and seconds of time may be ignored. Applying to the sidereal time of twilight the right ascension of any heavenly body gives its hour angle at twilight. With the sidereal time of twilight as a constant, the hour angles of all the navigational stars can be computed mentally by running down the table of mean places.

The solution of the problem is as follows: Put the tracing paper over the diagram, temporarily secured. Now considering the diagram as the projection in which the common axis of intersecting great circles (meridians) passes through the poles and the

horizontal diameter represents the equator, mark on the tracing paper the center of the projection and the elevated pole, the latter on the circumference bounding the projection. Next on the tracing paper plot the projected position of any star or planet by its co-ordinates of hour angle and declination, seen through the paper from the diagram. This plotted position is correctly situated with reference to the center and the elevated pole, on the scale of the diagram, however the tracing be turned. Fig. 2 may be taken to represent the tracing paper, except that in actual work only the points *C*, *P* and *X* need be marked; all else is superfluous. The point *X* represents the projection of a star at twilight (west of the meridian, say) whose actual hour angle is 45° (3 hours), and whose actual altitude is 40°. It is found by marking on the tracing paper the intersection, seen through the paper, of the hour circle *PXS*, 45° from *Q* (*QV*=projected 45°), and the declination circle *aXb*, 40° from *EQ*.

Now forgetting the tracing for a moment, consider the diagram as a projection on which intersecting great circles have a common axis passing through the zenith and nadir, and the horizontal diameter represents the horizon (Fig. 3, dotted lines). Since the projection is on the plane of the meridian, and since all meridians pass through the poles, the elevated pole will be on the circumference of the projection, and its position thereon will be above the horizon line at the point where the circumference is cut by the circle of altitude that is equal to the latitude (latitude equals altitude of the elevated pole). Note this point, on the right side or the left, it makes no difference. In Fig. 3 it is *P*, taken 20° from *H* on the left side. The elevated pole will be considered north.

Reverting to the tracing paper, revolve it with its center mark over the center mark of the diagram until the elevated pole marked on the tracing is directly over the noted position of the elevated pole on the diagram. As said above, the plotted position of the heavenly body on the tracing paper is its correct projection with reference to the pole and the center, in whatever place on the bounding circumference the pole may be. In Fig. 3, the full lines represent the tracing paper, the pole has been revolved to *P* from its original position vertically above *C*, and *X* has been revolved until it occupies the position *X'*. *X'* is in exactly the same position relative to *P* and *C* in Fig. 3 that *X* was in Fig. 2.

Hence, since the pole on the tracing paper has been revolved to its proper position with reference to the zenith of the diagram, the point on the *diagram* immediately under the projected position of the heavenly body on the tracing is the proper projection of the body on the diagram with reference to the zenith and center, and its co-ordinates of azimuth and altitude can be read off from the diagram through the tracing paper. Thus in Fig. 3, where the dotted lines represent the diagram seen through the tracing paper, the point X' is seen to lie on the intersection of the azimuth circle $ZX'N$ and the altitude circle $cX'd$. The azimuth is measured by the projected arc HY, and is $N\ 52\frac{1}{2}^\circ\ W$ in this case; the altitude is measured by the arc Hc (or Rd), and is 47° in this case. The full lines, though unnecessary and not traced in practice, have been left in Fig. 3 to assist in keeping in mind that X' on the tracing paper is correctly projected with reference to P and C by its co-ordinates of hour angle and declination.

What has been described for one star or planet can be done for all of them that are useful for navigation by one plotting on the tracing paper and one revolution of the paper for latitude, and thus by ten or fifteen minutes' work the navigator may prepare a table of the visible navigational stars by the aid of which he can instantly identify any one; and from the same table he can decide which will give the best cuts.

In practice, the table will not contain many stars and planets. In the first place, the number of stars ordinarily used for navigation is limited. Then again, some will be below the horizon, and others will not be above the horizon a sufficient distance, say 10°, for reliable results. To eliminate the latter the procedure is as follows: After marking the pole and center on the tracing, revolve the paper until the pole corresponds with the latitude as explained above, and secure it temporarily. Then mark on the tracing paper the 10° circle of altitude that is above the horizontal line of the diagram, after which revolve the tracing paper back until the pole on it is again over the upper pole of the diagram, which is the proper position for plotting by hour angle and declination. Then in plotting the projection of stars or planets on the tracing paper by these co-ordinates, if any one is seen to fall *below* this 10° circle it is rejected. This is a simple matter of inspection in most cases. In Fig. 2, the 10° circle is shown by the broken dotted arc

mn. Each star or planet that plots below (to the left of) this arc goes out at once.

There are two things that, unless understood clearly and kept in mind, will be a source of trouble in using this method. The first of these is that the hour angle must be measured from the extremity of the equator that is on the side from the center that is *opposite* to the one on which the pole will fall when the tracing is revolved. Thus. in Fig. 2, hour angle must be measured from *Q*, not from *E*, because in Fig. 3 the tracing has been revolved with the pole toward *E*. The reason is that the origin of hour angle is the meridian, zero hours occurring at the time of upper transit; moreover, for any heavenly body that can be observed at all, *i. e.*, for any heavenly body whose upper transit can be seen above the horizon, upper transit takes place on the arc of the meridian that includes the zenith, and whose extremities are the elevated pole and the horizon. The intersection of this arc of the meridian with the horizon is necessarily on the opposite side of the zenith from the pole.

The second source of possible difficulty is to know whether any particular heavenly body will be east or west of the meridian. The diagram serves to represent equally well the projection of a body on either side of the meridian; but as two bodies of the same declination, symmetrically placed on opposite sides of the meridian, will plot superposed on the plane surface of the diagram, it is necessary to exercise care in determining whether the azimuth in any particular case is to be east or west. A thumb rule for determining the name of the azimuth is as follows:

If the sidereal time is greater than the heavenly body's right ascension, the *azimuth* will be *westerly* if the difference of the two is less than 12 hours, and *easterly* if that difference is greater than 12 hours. The contrary holds if the right ascension is greater than the sidereal time.

Better than any rule is a rough projection on the plane of the equator showing the relative traces of the meridians passing through the place, the star and the First Point of Aries.

Azimuth is, of course, reckoned as North so many degrees East (or West), or South so many degrees East (or West), according as it is measured on the diagram from the end of the horizon line nearer to or further from the position of the elevated pole (considered North here) in its revolved position on the tracing.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A GRAPHIC METHOD FOR DETERMINING THE ALTITUDE OF AEROPLANES.

By Prof. Giuseppe Pesci, of the Royal Naval Academy at Leghorn.

Translated from *Rivista Tecnica di Aeronautica*, N. 3, May–June 1911, By F. W. Morrison and C. W. Frederick.

1. The altitude of an aeroplane may be determined in the following manner:*

Establish a horizontal base AB (Fig. 1), and let P be the aeroplane, and H its projection on the horizontal plane passing through AB. With two theodolites measure the angles of elevation

$$HAP=\alpha', \qquad HBP=\beta',$$

and the angles in azimuth

$$HAB=\alpha, \qquad HBA=\beta.$$

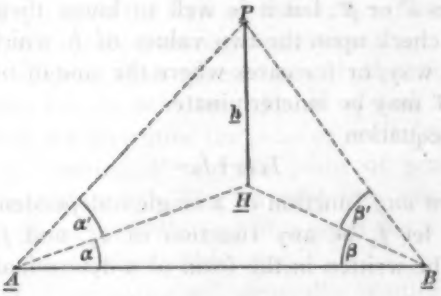


Fig. 1.

Then, assuming AB as the unit of length, let

$$\frac{HP}{AB}=h, \qquad \frac{AH}{AB}=m, \qquad \frac{BH}{AB}=n.$$

*Henri Petit: *Comment on mesure l'altitude atteinte par les aéroplanes.* "La Nature," 19 Novembre, 1910.

By trigonometry we have at once

$$m = \frac{\sin \beta}{\sin (\alpha+\beta)}, \tag{1}$$

$$n = \frac{\sin \alpha}{\sin (\alpha+\beta)}, \tag{2}$$

$$h = m \tan \alpha', \tag{3}$$

$$h = n \tan \beta', \tag{4}$$

whence

$$h = \frac{\sin \beta \tan \alpha'}{(\sin \alpha+\beta)} \tag{5}$$

or

$$h = \frac{\sin \alpha \tan \beta'}{\sin (\alpha+\beta)}. \tag{6}$$

We propose to construct a nomogram which will do away with the numerical computation of the above formulæ. Among the different types that might serve for such a purpose, we believe the most suitable is that obtained by superposing two nomograms with circular scales.* The principle of their construction is so simple that it can be understood even by those who are unacquainted with the elements of nomography. Thus we hope to increase to some extent the interest in this new and fertile science.

NOTE.—It would evidently be sufficient to know only one of the two angles α' or β', but it is well to know them both, either to serve as a check upon the two values of h which can be obtained in this way, or for cases where the sine of one of the two angles α' or β' may be indeterminate.

2. In the equation

$$f_1 f_2 + f_3 = 0 \tag{7}$$

let f_1 represent *any* function of a single independent variable z_1, and similarly let f_2 be any function of z_2, and f_3 of z_3. The equation can be written in the form of a determinate as follows:

$$\begin{vmatrix} 1 & f_1 & 1+f_1^2 \\ 1 & f_2 & 1+f_2^2 \\ 1 & 0 & 1+f_3 \end{vmatrix} = 0, \tag{7'}$$

* Nomograms of superposed conical scales were brought to notice by Clark, Professor at the Politecnico di Cairo. See *Théorie générale des abaques d'alignement.* "Revue de Mécanique," 1907. Also see D'Ocagne, *Calcule graphique et Nomographie.* "Encyclopédie scientifique", Doin.

as may be easily verified. Then referring to a system of rectangular axes,* the three points

$$x_1 = \frac{1}{1+f_1} \qquad y_1 = \frac{f_1}{1+f_1^2}, \tag{8}$$

$$x_2 = \frac{1}{1+f_2} \qquad y_2 = \frac{f_2}{1+f_2^2}, \tag{9}$$

$$x_3 = \frac{1}{1+f_3} \qquad y_3 = 0 \tag{10}$$

are seen to be in a straight line. From (8) it is clear that upon varying z_1 the locus of the points (x_1, y_1) is a circle, for by eliminating f_1 we obtain

$$x^2+y^2-x=0.$$

From (9), upon varying z_2, the locus of the points (x_2, y_2) is the same circle. And from (10), varying z_3, the locus of the points (x_3, y_3) is the axis of abscissas.

Having shown this, let us give to z_1 a series of values (in arithmetical progression, for example), and by means of equations (8) compute the coordinates (x_1, y_1) corresponding to each value of z_1. When we plot these points they will fall on the circle mentioned above, and we may assign to each the corresponding value of z_1, which will then be its scale value. Thus we obtain scale (z_1). Similarly if we vary z_2, we shall obtain scale (z_2), upon the same circle. And by varying z_3, we shall obtain scale (z_3), upon the axis of abscissas. These three scales, when plotted, constitute a nomogram.

It is now evident that, given two of the three quantities z_1, z_2, z_3, which satisfy equation (7), as z_1 and z_3, in order to obtain the third, we determine the point of scale (z_1) which represents the scale reading z_1, and the point of scale (z_3) which represents the reading z_3. The straight line joining these two points will intersect the scale (z_2) at a point the scale reading of which will be the required value of z_2.

The reading of the scales will generally require an interpolation by eye.

NOTE I.—The accuracy attained will always depend upon the dimensions of the figure.

NOTE II.—To construct the scales (z) we could also proceed graphically,† but for the sake of accuracy, and the checking of

* D'Ocagne, see p. 289.

† D'Ocagne, see pp. 171 and 290.

the figure, it is best to compute all three of the scales numerically from the equations (8), (9), and (10).

NOTE III.—Instead of tracing the connecting line upon the design, it is better to use a fine thread.

3. With the above as a basis, we see that by introducing two arbitrary constants k_1 and k_2 we may write equation (1) in the form

$$k_1 m \frac{k_2}{k_1} \sin(\alpha+\beta) - k_2 \sin\beta = 0,$$

which is similar to equation (7), if we make

$$z_1 = m \qquad f_1 = +k_1 m,$$

$$z_2 = \alpha+\beta \qquad f_2 = -\frac{k_2}{k_1}\sin(\alpha+\beta),$$

$$z_3 = \beta \qquad f_3 = +k_2 \sin\beta.$$

With these [or similar equations from (2)] we can construct a nomogram as explained in the previous paragraph.

Introducing another arbitrary constant l, the scales of this nomogram may be computed by writing equations (8), (9) and (10) in the following form:

$$x_1 = +\frac{l}{1+(k_1 m)^2} \qquad y_1 = +\frac{l k_1 m}{1+(k_1 m)^2}, \tag{11}$$

$$x_2 = +\frac{l}{1+\left(\frac{k_2}{k_1}\right)^2 \sin^2(\alpha+\beta)} \qquad y_2 = -\frac{l\frac{k_2}{k_1}\sin(\alpha+\beta)}{1+\left(\frac{k_2}{k_1}\right)^2 \sin^2(\alpha+\beta)}, \tag{12}$$

$$x_3 = +\frac{l}{1+k_2 \sin\beta} \qquad y_3 = 0. \tag{13}$$

The common basis of the two scales (m) and $(\alpha+\beta)$ will be a circle with center at $\left(\frac{l}{2}, 0\right)$, and radius $\frac{l}{2}$.

Thus we obtain Fig. 2, in which we have taken $l=4$ cm. and $k_1=k_2=1$. From this nomogram, if we put $\alpha=130°$, and $\beta=30°$, we find $m=1.4$.

NOTE I.—The values of y_1 and y_2 can be obtained from those of x_1 and x_2 by noting that

$$y_1 = [k_1 m] x_1, \qquad y_2 = -\left[\frac{k_2}{k_1}\sin(\alpha+\beta)\right] x_2,$$

and the computation of x_2 can be simplified through the well-known relation

$$\sin^2(\alpha+\beta)=\tfrac{1}{2}[1-\cos 2(\alpha+\beta)].$$

NOTE II.—Having computed scale (β), the scale $(\alpha+\beta)$ may be obtained from it, for when $m=1$ we have from equation (1) $\sin\beta=\sin(\alpha+\beta)$, whence reducing $(\alpha+\beta)$ to the first quadrant (if necessary), the points of the two scales having the same value must fall on a straight line with the point $m=1$. For the sake of accuracy, however, it is advisable to make use of this property only as a check upon the computations.

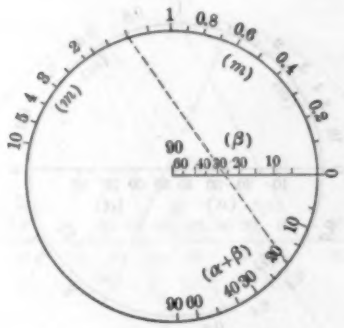


FIG. 2.

4. Introducing another arbitrary constant k_3, the equation (3) can be put in the form

$$k_1 m \frac{k_3}{k_1}\frac{1}{h} - k_3 \cot\alpha' = 0,$$

which is similar to equation (7), if we put

$$z_1 = m \qquad f_1 = +k_1 m,$$

$$z_2 = h \qquad f_2 = -\frac{k_3}{k_1}\frac{1}{h},$$

$$z_3 = \alpha' \qquad f_3 = +k_3 \cot\alpha'.$$

With the above [or similar equations from (4)] we can construct a nomogram like the preceding one. If we give to l and k_1 the same values they had in the preceding case, the new scale (m) will be the same as before.

Scales (h) and (α') are then obtained from the formulæ

$$x_4 = + \frac{l}{1+\left(\frac{k_2}{k_1}\right)^2 \frac{1}{h^2}} \qquad y_4 = - \frac{l \frac{k_2}{k_1} \frac{1}{h}}{1+\left(\frac{k_2}{k_1}\right)^2 \frac{1}{h^2}}, \tag{14}$$

$$x_5 = + \frac{l}{1+k_2 \cot \alpha'} \qquad y_5 = 0, \tag{15}$$

Thus we construct Fig. 3, in which l and k_1 have the same value as in the preceding figure, and $k_2 = 1$. From this nomogram, if we put $m = 1.4$ and $\alpha' = 50°$, we find $h = 1.6$.

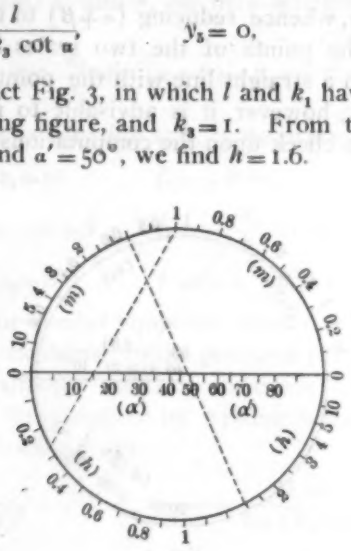


FIG. 3.

NOTE I.—The values of y may be obtained by noting that

$$y_4 = - \left[\frac{k_2}{k_1} \frac{1}{h} \right] x_4.$$

Also, having constructed the scale (α') from 0° to 45°, we see that when $k_2 = 1$ the remaining part of the scale is symmetrical with the first in respect to the center of the circle, for it is evident

$$\frac{l}{1+\cot \alpha'} + \frac{l}{1+\cot (90° - \alpha')} = l.$$

NOTE II.—If it were not for the checking mentioned before (Art. 2, Note II, and Art. 3, Note II), having computed scale (m), the calculation of scale (h) would be unnecessary, for two reasons: First, when $\alpha' = 45°$ we have $h = m$; consequently the points which in the two scales have equal values, are in a straight

line with the point $a'=45°$. Second (true only when $k_3=1$), for equal values of h and m we have

$$x_1+x_4=l \quad \text{and} \quad y_1=-y_4;$$

hence scale (h) is the same as scale (m) revolved 180° about the center of the circle.

5. In Fig. 4 the two preceding nomograms are superposed and drawn to a larger scale (making $l=6$ cm. instead of $l=4$ cm. to show the details of the figure more clearly), and since the problem requires h only, the common scale (m) is left blank. The resulting abacus is a circular one of double alignment and four variables.*

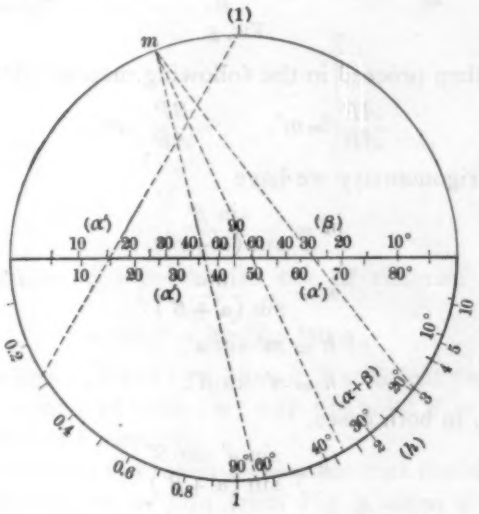


FIG. 4.

From the preceding we see that if we have given a, β and a' to find h, we first join the point $a+\beta$ of the scale $(a+\beta)$ to the point β of the scale (β) by means of a straight line, and thus determine another point where this connecting line cuts the circle [this point would give the value of m, if we had constructed the scale (m)]. Next we join this point to the point a' of the scale (a') by means of a straight line, and the point at which this connecting line cuts scale (h) gives the required value of h.

From the above figure, when $a=130°$, $\beta=30°$, $a'=50°$, we find $h=1.7$

*D'Ocagne, see p. 330.

6. If H falls on the base AB, Fig. 5, our method fails, because the values of m and n, given by (1) and (2), and consequently the values of h, given by (5) and (6), are represented in an indeterminate form, which is shown in the nomogram by the coincidence of the points β and $\alpha+\beta$.

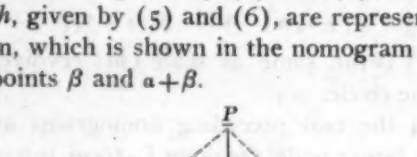


FIG. 5.

We may then proceed in the following manner: Put

$$\frac{AP}{AB}=m', \qquad \frac{BP}{AB}=n',$$

whence by trigonometry we have

$$m'=\frac{\sin\beta'}{\sin(\alpha'+\beta')}, \tag{16}$$

$$n'=\frac{\sin\alpha'}{\sin(\alpha'+\beta')}, \tag{17}$$

$$h=m'\sin\alpha', \tag{18}$$

$$h=n'\sin\beta', \tag{19}$$

from which, in both cases,

$$h=\frac{\sin\alpha'\sin\beta'}{\sin(\alpha'+\beta')}. \tag{20}$$

Comparing (16) with (1) we see that to obtain m', given α' and β', the same nomogram will serve, Fig. 2, that was used to find m from α and β; we need only substitute α' and β' for α and β in reading the scales $(\alpha+\beta)$ and (β). Next, comparing (18) with (3), it is clear that we pass from the latter to the former by substituting $\sin\alpha'$ for $\tan\alpha'$; therefore in the nomogram represented by Fig. 3, instead of the scale (α') given by (15), it is necessary to construct the scale given by

$$x_6=\frac{l}{1+k_2\csc\alpha'}, \qquad y_6=0. \tag{21}$$

In the complete nomogram, Fig. 4, this new scale is marked $((\alpha'))$ and with it, when $\alpha'=130°$, and $\beta'=30°$, we find $h=1.1$.

In Fig. 5 it is assumed that H falls between A and B, but even if this is not so, the method will still be general if by α' and β' the angles BAP and ABP are understood.*

NOTE.—When $k_2=k_3=1$, we see that for equal values of α' and β, we have

$$x_3+x_6=l.$$

Thus, with respect to the center of the circle, the scale $((\alpha'))$ is symmetrical with scale (β) and therefore need not be computed.

7. Another case, which in reality comes under the preceding special case, is that in which H falls on A or B, Fig. 6. It would be sufficient to proceed as in the above paragraph, assuming $\alpha'=90°$, or $\beta'=90°$.

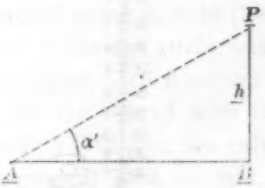


FIG. 6.

However, equation (20) reduces to one of the two following forms:

$$h=\tan\beta', \quad \text{or} \quad h=\tan\alpha',$$

as doalso equations (4) and (3); thus it is sufficient (see Fig. 3) to connect the point 1 of scale (m) with the point β' or α', of the scale (α'), to obtain h directly.

In Fig. 4 the point $((1))$ is also the point 1 of the blank scale (m). From this figure, as also from Fig. 3, when $\alpha'=15°$ we find $h=0.26$.

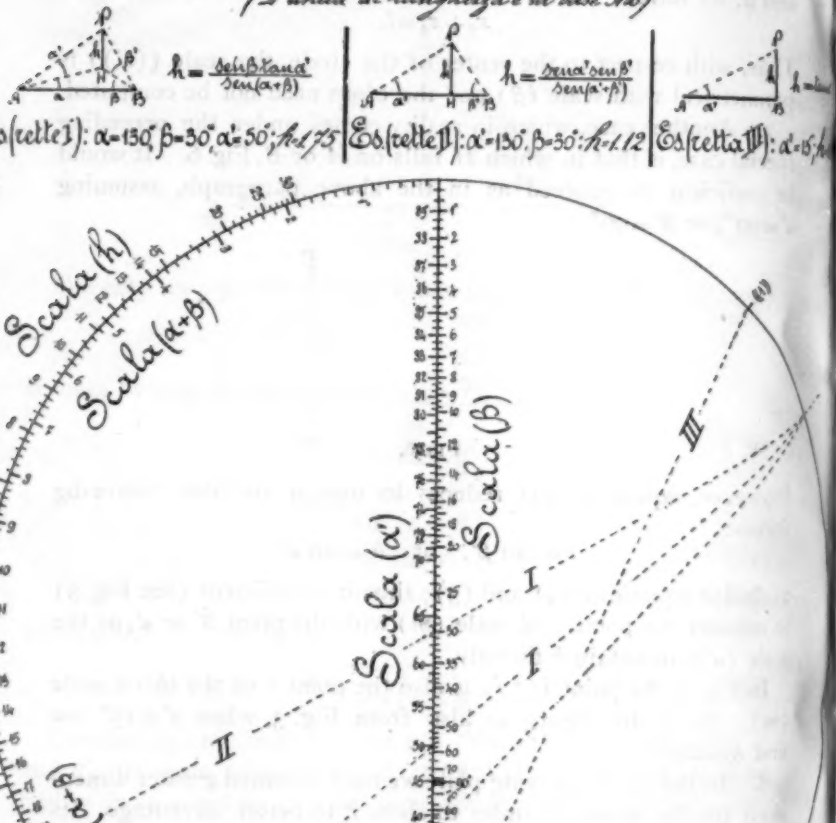
8. In the accompanying plate we have assumed greater dimensions for the abacus in order to show it to better advantage. Its arrangement has also been changed to facilitate its use.

The coefficients k_1, k_2, k_3, have been so chosen that scale (h), from 0 to 30, may be as distinct as possible; to this end, after a few trials, it has been found satisfactory to assume $k_1=0.4$ and $k_2=k_3=2$.

*The graph of M. Petit is not only restricted to the case discussed in this paragraph, but is also limited by the hypothesis that H falls between A and B. Yet "... son exactitude, très supérieure à celle du baromètre, l'a fait adopter à peu près partout où il y a des *grandes semaines*."

Abbaco
per il calcolo dell'altezza di un aeroplano

(L'unità di lunghezza è la base AB)



The coefficient l has been taken equal to 20 cm., but with a design four or five times this size we could certainly reach approximations, in portions of the base AB, of $\frac{1}{100}$ when h is between 0 and 5, $\frac{1}{50}$ when h is between 5 and 10, $\frac{1}{25}$ when h is between 10 and 15, and $\frac{1}{10}$ when h is between 15 and 30, and, considering the nature of the problem, especially the instability of the point observed, with a base AB not less than 50 m., this degree of accuracy is more than sufficient.*

From what has been said in Note III to Art. 2, and also in Art. 5, the nomogram can be used in the following manner: Hold a thread at the point $\alpha+\beta$ with the left hand; then keeping it taut with the right hand, revolve until it passes through the point β. Then, without releasing it, hold the thread with the right hand at the point where it cut the circle, and keeping it taut with the left hand revolve it again until it passes through the point α'. The final intersection of the thread with the circle will be the point whose scale reading will give the value of h. This would be the process for the general case of Art. 5, and similarly for the cases of Art. 6, and Art. 7.

Thus in the example of Art. 5, viz., given $\alpha=130°$, $\beta=30°$, and $\alpha'=50°$, we find with greater precision (see the dotted lines I) $h=1.75$.

In the example of Art. 6, viz., given $\alpha'=130°$ and $\beta'=30°$, we find the more exact value (see the dotted lines II) $h=1.12$.

And in that of Art. 7, viz., given $\alpha'=15°$, we find (see the dotted line III) $h=0.27$.

These examples are sufficient to show how to proceed in every case.

NOTE I.—For the computation of y_1, y_2, x_2, and y_4, the simplifications indicated in Note I to both Art. 3 and Art. 4 still hold. But those indicated for the computation of scale (α') in Note I to Art. 4, and for $((\alpha'))$ in the Note to Art. 6, are no longer possible. And if scale (m) is not computed, the simplification mentioned in Note II to Art. 4 has no basis.

*A closer approximation can only be deceptive, and in this connection M. Petit (q. v.) wisely remarks, "Appearances of accuracy are attained that are amusing: a recent official record has been announced at 2682 *meters* . . . a little more and they would have given centimeters."

NOTE II.—With a large model the empty spaces might be advantageously filled with directions for the use of the abacus Also there would be room enough to write two sets of supplementary numbers for the corresponding scales, and thus do away with the reduction to the first quadrant in those cases where β or $\alpha+\beta$ is an obtuse angle.

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THE ITALIAN-TURKISH WAR.

(CONTINUED.)

By COMMODORE W. H. BEEHLER, U. S. Navy.

(Compiled and translated from the *Marine Rundschau*, and other sources.)

THE COST OF THE WAR.

The approved estimates in the Italian Parliament, in March, 1912, show that for the period of five months ending February 29, 1912, the current war expenses amounted to $41,495,000, of which $5,790,000 was for the navy, and $35,705,000 for the army; besides which $2,045,800 was expended for special purposes. $18,914,000 of the amount expended for the army included the cost of mobilization and conduct of the war—transportation of troops, maintenance of personnel, purchase of horses, ammunition, and war material—for the troops in Africa; and $11,966,000 was expended to replace the personnel and war material transported to Africa in the standing army in Italy, and for organizing additional forces in Italy.

The $5,790,000 expended for the navy was for the extraordinary expense of maintenance, transportation, the increased complements of ships and subsistence with cost of fuel and material consumed.

The special sum of $2,045,800 was for harbor improvements at Tripoli, Homs, Benghasi and Derna, as well as for telegraph, telephone, and sanitary service in North Africa. This sum also defrayed the cost of laying new cables from Syracuse to Tripoli, and Syracuse to Benghasi.

The expenses of the army and navy thus estimated at $42,140,000 will be covered by the saving in the budget of 1910-11, some $11,172,000, and that of 1911-12—estimated at $14,504,000—together with $16,464,000 to be deducted from the regular budgets in the fiscal years 1912-13 to 1917-18. The apparently low cost of the war has been maintained by the economical administration

of the finances, and this expense amounts to about $260,680 per day. But an accurate estimate of the total cost of the war, of course, cannot be given until after the war is over, because there are many details that are not considered in the present estimates. Expert financiers estimate that the war has in the period ending February 29, 1912, cost a total of $57,900,000, or at a daily rate of $386,000.

The Italian finances were thus in favorable condition, especially as the administration received a large surplus by economy in the budgets during the recent years. The Italian people were willing to make great sacrifices for this war, so that there was no lack of money on the part of Italy to still further prosecute the conquest of Tripoli.

The Turks spent, up to the beginning of February, about twenty million francs chiefly for establishing the new coast defences. February 1, the war minister received an appropriation of $4,436,320 for coast defences.

The friendly offices of neutral powers to re-establish peace between the belligerents failed. On March 9 the diplomatic representatives of Germany, Austria, England, France, and Russia took a united step for this purpose with the Italian government at Rome. They asked confidentially upon what terms Italy would agree to suspend hostilities. The Italian government replied March 15, according to the *Corriere della Sera*, as follows:

Italy demands that Turkey shall recognize Italy's absolute sovereignty over the African provinces and withdraw all Turkish officers and troops from Africa, strictly forbidding Turkish officers to lead the Arabs in opposing the Italians; and Italy will then cease hostilities in all parts of the Turkish empire and reduce the imposts on Turkish goods to the former rates. Italy will, on the other hand, recognize the religious Caliphat and give amnesty to all natives. Italy will assume that part of the Turkish debt apportioned to Tripoli, and will purchase the Turkish government property situated in Tripoli from the Turkish government. Italy further promises to agree, with other powers, to preserve the integrity of the Turkish empire.

The Italian parliamentary discussion proves that the nation fully agreed with the chief demands of the Italian government.

It also appears that Russia had assembled troops on Trans-Caucasian frontier, had recalled the Russian Ambassador Tschary-

kow—who was in Constantinople for many years—and replaced him by Von Giers, the former minister in Bucharest. The Russian press also reported that a Russian fleet was ready to proceed to the Bosphorus in case the Italians forced the passage of the Dardanelles.

The Sultan presented the Shiek of Senoussi with a sword set with diamonds, a decoration, and other precious gifts in gratitude for his support of the war against the Italians.

Turkey replied to Italy's claim by reasserting her claim to full sovereignty over her African provinces, and the Arabians were determined to continue their resistance to the Italian conquest under all conditions. The Arabian representatives in Constantinople declared that they will continue the war even if Turkey yields the annexation of these provinces to Italy.

During the middle of March the Arabians in Tripoli and Cyrenaica elected delegates to the Turkish Parliament in Constantinople, and declared that the Italian proclamation of annexation of these two provinces to Italy was null and void.

MILITARY OPERATIONS UP TO THE MIDDLE OF MARCH, 1912.

The Turks determined to vigorously prosecute the war in Tripoli and Cyrenaica, and incessantly attacked the Italians at all points. At Tripoli the Italians were kept constantly alarmed by these attacks by day and night. The Italians also failed after repeated attempts to capture Zanzur which was occupied by the Turks in force, and which they fortified with artillery and machine guns. In attacks against Zanzur the Italians used, with but little effect, two dirigible balloons arranged for throwing various kinds of bombs and hand grenades.

The Italians collected 3000 burden-bearing camels and 300 riding camels for the camel corps in Tripoli. A battalion of Askaris and a camel riding detachment arrived from Erythrea late in February, and was vigorously attacked by Arabs on March 4 at Bir-el-Turki, the Askaris were routed, and only managed to escape into Tripoli under cover of darkness with heavy losses.

A Turkish attack on Ain Zara was repulsed on March 10. Malarial fever broke out in the camp at Ain Zara, and the garrison was relieved by other Italian troops. A portion of the camp adjoining a swamp was abandoned, and an advanced intrenchment

was captured by the Turks and gave rise to a report that Italians had abandoned Ain Zara.

A narrow-gauge railroad from Tripoli to Ain Zara was completed as far as Fornaci, which is 7 kilometers from Tripoli. The Italians built a field construction railroad to the stone quarries at Gargaresch for stone to build the breakwater at Tripoli.

At dawn of February 27, the Italian garrison at Homs surprised the Turks on the Mergheb heights, about four kilometers from the town and practically commanding the town. The bulk of the Turkish troops had been decoyed from the heights to oppose a feigned landing of Italians from a squadron of transports that appeared off Sliten, about 20 miles east of Homs. The Italians meanwhile intrenched their position on Mergheb heights so that when the bulk of the main body of the Turks returned from Sliten that evening, the Italians defeated them in their efforts to retake the heights. Subsequently the heights were strongly fortified and the Turks could not dislodge the Italians from their commanding position.

There were many fierce combats at Benghasi from March 8 to March 12. After these were repelled General Ameglio led a force of 7 battalions, with cavalry and artillery, to the oasis at Fogat, where he captured 500 Arabs after a desperate resistance. For this brilliant victory Major-General Ameglio was promoted to lieutenant-general.

Attacks by the Turks at Derna on March 3, and at Mirsa Tobruk on March 11 were repulsed with difficulty.

In these engagements in Cyrenaica during the month ending March 15, 1912, the Italians lost 193 killed and 350 wounded.

There was no probability of any decided advance by the Italians into the interior in the immediate future. The commander-in-chief, Lieutenant-General Canera, convinced the government at Rome that successful advances into the interior can only be made very gradually, and must be accompanied by railroad construction that will secure every step that may be gained. The chief of staff, Major-General Gastaldello, who originally advocated vigorously pushing the campaign into the interior, was relieved and replaced by Major-General Ciancio.

There was no probability of any substantial increase to reinforce the 100,000 troops in Africa, March 15.

The reserves serving in Africa were, however, relieved by men of the active army.

A German Red Cross detachment succeeded in reaching Gharian about March 1. This detachment consisted of three surgeons and 12 nurses, two of whom died of typhoid fever en route via Tunis. They attended the sick and wounded in the Turkish camp at Gharian.

At the beginning of April, 1912, the bulk of the Italian naval forces was in the home ports undergoing repairs and recruiting as in peace. Several divisions of torpedo boats and the four auxiliary cruisers, the *Duca-di-Genova, Duca-Degli-Abruzzi, Citta-di-Palermo* and *Citta-di-Messina,* cruised along the Turkish Mediterranean coasts and searched merchant ships of all nationalities for contraband of war. The naval forces stationed off the north coast of Africa participated in small engagements with the land forces on the coast; among other smaller engagements the *Etna* bombarded Hoeifa, a small place near Benghasi.

Vice-Admiral Faravelli was obliged to give up the command on account of a severe nervous ailment, and he was succeeded on April 9, 1912, by Vice-Admiral Viale, who had shortly before this assumed command of the second squadron. Vice-Admiral Amero d'Aste took command of the second squadron.

After the training of the new Italian recruits was completed, the reserves of 1887 were relieved.

The fourth division, comprising three *Garibaldis,* were in the harbors of Cyrenaica, partly at Tobruk and partly in the Gulf of Bomba. It is said that Bomba, which is 55 nautical miles west of Tobruk, will be the future naval port on the African Mediterranean coast. The reason for this change is stated to be that the magnificent harbor of Tobruk lacks adequate supply of potable water, and that there is an ample supply of potable water at Bomba, which can also be easily defended by means of the islands of Menelaus and Bomba that command the approaches to the bay. The depths of water and anchorages are about the same at Tobruk and Bomba, but the serviceable area of the harbor at Bomba is considerably greater. The anchorage at Bomba is only 70 kilometers from Derna, with which it could readily be connected by a railroad. In case Bomba should be selected as the Italian naval port, Tobruk would serve for a base for light naval forces.

As soon as the report of the occupation of Bomba was circulated a large portion of the Turkish-Arabian forces besieging Tobruk was withdrawn to Bomba.

The schoolship squadron of three *Sardegnas* reinforced by two armored cruisers under Vice-Admiral Borea Ricci resumed operations against Zuara. This force was joined by the armored cruisers *Carlo Alberto* and *Marco Polo,* with the auxiliary cruisers *Citta-di-Catania* and *Citta-di-Syracusa,* six torpedo boats, three naval tugs and three transports having the two battalions of grenadiers on board, that sailed from Tripoli westward along the coast on April 8, 1912, for Zuara. En route the latter force bombarded coast places and finally anchored, April 9, 2000 meters distant from the coast in the newly surveyed harbor at Zuara.

The naval vessels began to bombard the town and fired shells all day at intervals of five minutes until night. The next morning 20 armed boats put off from the three transports and, favored by good weather, made a feint at landing. The armored cruisers at the same time vigorously bombarded the town. This bombardment, however, caused no serious damage, but with the feigned landing had the effect of deceiving the enemy and prevented them from opposing the landing of the Garioni division of infantry at a point about 40 kilometers northwest of Zuara. This division of about 10,000 men had embarked at Augusta in 7 transports during the night of April 7, and under the convoy of the schoolship division arrived during the night of April 10 at the peninsula of Macabez on the Tunisian border. With the support of the warships, including a number of torpedo vessels, *Agordat, Iride,* and 6 high-sea torpedo boats, that had sailed from Tripoli and had met the convoy at sea en route. The navy immediately sounded out a channel and a landing place in this difficult locality that enabled the army to begin landing at 3 a. m. and complete the disembarkation the same day without any disturbance by the enemy.

By noon the next day a detachment of naval brigade and Askaris also took possession of the small fort Forwa, or Bu Kamez, at the southern end of the Macabez peninsula about 35 kilometers from Zuara.

The Turkish-Arabian forces did not appear until after the Italians had secured possession of this fort and that attack was repulsed. The Italians then still further fortified their positions

on the peninsula and prepared for their advance upon Zuara from this new base.

A small bay 6 miles long and 1½ miles wide served as a good anchorage for the Italian vessels, and this place has been established as a torpedo boat station for the Italian torpedo craft.

April 12 the Italian military balloons P-2 and P-3 arrived from Tripoli. These balloons had reconnoitered the Turkish-Arabian positions at Zuara, and gave the Italians at Fort Bu Kamez written descriptions of the enemy's strength and positions at Zuara. The balloons then returned off Zuara, where by means of four small anchors, the balloons were anchored close to the Italian warships from which they were supplied with gas and benzine. They then returned to Tripoli, 120 kilometers distant, after an absence from Tripoli of about 12 hours.

The transportation of contraband of war from Tunis via the coast road Ben Gardane was thus cut by the Italian occupation of Bu Kamez. This obliged the contraband trade to take the more difficult and longer route via Dehibat-Nalut, about 150 kilometers further in the interior.

Although reports of Italian operations in the Aegean Sea had subsided the Turks continued to maintain their defences in readiness, especially in regards to the mine fields in the Dardanelles. The Turkish fleet remained inactive in the Straits of Dardanelles, off Nagara.

April 13 the Italian first squadron, consisting of the *Vittorio Emanuele, Roma, Napoli* and three armored cruisers of the *Pisa* class, sailed from Tarento with the *Vettor Pisani*, flagship of the Duke of Abruzzia, and a number of flotillas of torpedo boats. The press reported that this fleet had sailed for Tripolitan waters to relieve the naval vessels operating there, but the fleet went to the Aegean Sea to make a naval demonstration on the Turkish coasts. Simultaneously the second squadron sailed from Tobruk and Augusta for the same destination. This force comprised the flagship *Regina Margherita, Benedetto Brin, St. Bon, E. Filiberto,* three armored cruisers of the *Garibaldi* class, three auxiliary cruisers and three naval colliers.

The fleet united during the night of April 17 near the island of Stampalia, west of Rhodes, and steamed the next morning at a speed of twelve knots to the northern part of the Aegean Sea, with

the flotillas of torpedo destroyers in advance. The third division under Vice-Admiral Amero d'Aste remained in the southern part of the Aegean Sea.

The main body of the Italian fleet arrived in the northern extremity of the Aegean Sea during the night of April 18, and cut the cables between Imbros and the Dardanelles as well as that from Lemnos to Salonica and Tenedos. At dawn the fleet was off Enos. At 6.30 a. m., Vice-Admiral Viale steamed thence southward towards the western entrance of the Dardanelles with the *Pisa* and *Amalfi* well advanced in order to entice the Turkish squadron out of the Dardanelles. About 9 a. m. a Turkish torpedo chaser was sighted off the entrance but immediately withdrew within the straits upon the approach of the *Garibaldi* and *Varese*. The outer Turkish forts then opened fire from the four coast forts of the Dardanelles, Kum Kaleh and Orhanie on the Asiatic side, and Sedil-Bahr and Ertogrul on the European side. These partly modern fortifications mounted 18 heavy Krupp guns of 8-inches to 11-inches caliber.

The Italian ships returned the fire at a range of about 8000 meters and fired for a period of two hours. The three ships of the first division bombarded the two forts on the European side and the five ships of the second and fourth divisions engaged the forts on the Asiatic side. Turkish reports estimate that the Italians fired 342 projectiles. The forts, especially Fort Orhanie, were severely damaged. The barrack buildings were hit frequently, and in the fort Sedil-Bahr alone the Turks suffered 15 men killed and 18 wounded.

The Turkish fire was ineffective, about 150 Turkish projectiles were fired. The Italian official report states that the Italian ships sustained no damage, and they expressly denied the Turkish reports that the *Varese* had been set on fire by the Turkish projectiles.

The Turks closed the Dardanelles to all shipping upon the appearance of the Italian fleet, and all the openings in the mine fields were closed.

While the main body of the fleet was engaged at the Dardanelles, the third division was active in the south. The battleship *Emanuele Filiberto* arrived at 5 a. m. with the torpedo-boat *Ostro*, off Bathi, the chief port of the island of Samos which has 10,000 inhabitants, and without any notice immediately opened fire on the

infantry barracks for 1200 men, and completely destroyed them. A Turkish gunboat that was in the harbor was sunk, the Italians claim, by a torpedo fired from the *Ostro*, while the Turks claim she was sunk by her own crew. The Italians departed immediately after sinking the gunboat.

The *Regina Margherita* and *Benedetto Brin*, each with a torpedo boat, cut the cable between Rhodes and Marmarice at both cable landings.

April 19 the main body of the Italian fleet started back to Italy leaving the third division with the *Pisa Amalfi* and a number of flotillas of torpedo boats to operate on the coast of Asia Minor and continue to destroy the cable communications. Among other places attacked they destroyed the telegraph station at Chios and that at Tschesme opposite Chios. They destroyed the radio station at Guelemich, opposite Rhodes, that formerly kept communication with the radio station at Derna, besides which they destroyed a telegraph station at Smyrna. These cable and telegraph stations were partly the property of the Turkish government, and partly belonged to the Eastern Telegraph Company.

The Italian fleet made this demonstration the day the House of Deputies opened its sessions in Constantinople with the newly elected delegates. The address from the Turkish throne on this occasion was: "The unjustifiable war waged by the Italians still continues notwithstanding the earnest desire for peace. We also desire peace, but we cannot make peace except upon the condition that the maintenance of our sovereign rights shall be preserved intact effectively."

The Italian press designated the naval demonstration a protest against the address from the throne, as the tenor of that address was anticipated.

Since sixty steamers with an average of 4000 register tons passed through the Dardanelles daily, neutral trade was badly crippled by closing the Straits of Dardanelles. French and Russian shippers complained to their ambassadors in Constantinople, and demanded damages from the Turkish government for stopping the commerce. The ambassadors and foreign governments, however, delayed action because the Turks declared, on April 19, that the Dardanelles would be open to commerce as soon as there appeared to be no immediate danger of further attacks by the Italians.

The reopening of the Dardanelles was, however, still postponed, because some Italian ships and destroyers continued to operate in the Aegean Sea.

As the Turks had long expected such an attack by the Italians they were fully prepared to resist it, and consequently the Italian attack did not cause any serious damage nor induce a panic among the people.

Speculators attempted to raise the price of provisions, whereupon the authorities in Constantinople published a decree that ample provisions were available in the government depots, and that the supply of provisions in the markets was ample. All persons concerned in efforts to raise the price of provisions would be summarily tried by martial law.

April 16 the representatives of the great powers interrogated the Sublime Porte to ascertain under what conditions Turkey would consider negotiations for peace. The Turkish reply was in substance that which was expressed in the address from the throne to Parliament.

Rear-Admiral Williams having retired from the duty of reorganizing the Turkish fleet, the British Rear-Admiral Limpus, on the active list, was appointed to relieve him, and he arrived at Constantinople about the end of April with his staff of British officers to train the Turkish navy.

The blockade in the Red Sea was extended to about double its former extent, and was declared to embrace the east coast of Arabia on the Red Sea for a distance of 83 nautical miles, from latitude 14° 30′ N. to 15° 50′ N., and included the ports of Hodeida, 2000 inhabitants, Loheija, of 45,000 inhabitants, and Kamaran Island. Neutral ships were allowed five days after the declaration of the blockade during which to leave those ports. Neutral ships engaged in transporting pilgrims to Mecca were allowed to visit the sanitary station on Kamaran Island upon condition that those vessels should pass the southern coasts of that island under the escort of an Italian blockading vessel. The Italians made much of the fact that pilgrimages to Mecca were not interrupted by the Italian blockaders.

After the *Calabria* returned to Italy, the Italians had, after the middle of April, the following naval forces in the Red Sea: The four protected cruisers, *Piemonte*, flagship, *Puglia*, *Liguria*, and *Elba*; the four gunboats, *Aretusa*, *Caprera*, *Volturno* and *Govern-*

olo, the surveying ship *Staffetta* and the four destroyers, *Artigliere, Bersagliere, Granatiere* and *Garibaldino*.

ITALIAN MILITARY OPERATIONS IN AFRICA.

During April the Italian military operations were comparatively quiet. The Turkish-Arabian forces attacked all the coast places occupied by the Italians, but were invariably repulsed without penetrating the Italian lines. A fanatical attack at Mirsa Tobruk was a desperate affair, but badly conducted and disastrously repulsed. Enver Bey claimed a victory at Derni but this was disputed by the Italians whose lines were not penetrated. The Italians did not make any advances into the interior and such an advance did not appear probable soon.

The expedition against Zuara that has been related under the naval operations was the most important of all the Italian operations in Africa in April.

Aeroplanes and balloons made frequent reconnoitering flights, and at times threw bombs upon the enemy with contradictory reported results.

The railroad from Tripoli to Ain Zara was put in operation March 19, and the field railroad to Gargaresch was being built.

The Turkish-Arabian forces in the interior were constantly reinforced, and it is estimated that they had from 15,000 to 20,000 troops before Tripoli. In Cyrenaica the Turks had about 40,000 troops, but they were outnumbered there by the Italians. In Cyrenaica the Arabs were temporarily weakened by the departure of numbers to cultivate their fields in the interior. The Arabs were still enthusiastic for continuing the war, and the reports of their being weary of the war are not well founded.

Twenty-three thousand Italian reservists, of the year 1888, were relieved from active war service in Africa; but there was some delay in getting these reserves home again, and there was consequently some dissatisfaction in regard to these reserves in Italy. New troops were being assembled during April at Naples to replace these reserves in Africa.

In the Red Sea the Arabian insurgent Said Idriss still co-operated with the Italians in the operations against the Turks in that region. Latest reports from Turkish sources claim that Said Idriss had been badly defeated by the Turks, but this lacks confirmation.

NAVAL OPERATIONS.

On April 17 the Italian navy established a rendezvous on the island of Astropalia, which has about 2500 inhabitants, as a base for all the auxiliary vessels of the Italian navy operating in the Aegean Sea. The auxiliaries comprised transports, colliers, distilling ships, tank ships, and ammunition ships. The Italians took possession on April 28, a naval force from the *Pisa* and *Amalfi* of 250 men landing, and capturing the Turkish garrison of seven men. The large open bay on the southern coast of the island was made a temporary naval base, and all the vessels seized by the Italian torpedo boats in the Aegean Sea from Crete to Enos were brought here for action by prize courts.

The exact results of the Italian naval bombardment on April 19, at the Dardanelles, are disputed. It is, however, established that the damage inflicted by the heavy naval guns at 7000 meters on the forts was severe, as the Turkish batteries were frequently hit and the Italians fired more projectiles than the Turks. The Italians may have sustained some slight injury to the rigging of their ships but no serious damage.

But the immediate effect of the Italian naval demonstration was of much greater importance and interest to the commerce of Russia from the Black Sea ports.

The necessity of England's neutrality was emphasized in Parliament because of the vast number of British subjects among the Mahomedans and their interests, and, on the other hand, England's long traditional friendship with Italy.

The British trade was seriously damaged by closing the Dardanelles, but Viscount Morley pointed out that Turkey was justified by the treaties of Paris in 1856, of London in 1871, and Berlin of 1878, to close the Dardanelles as long as the Italian naval forces threatened the security of Constantinople.

April 20 the Russian government protested to the Sublime Porte against closing the Dardanelles by the Turks in violation of the Berlin treaty, and to the great injury of Russian commerce. This act seriously crippled the export trade of the Black Sea that amounts to about $315,000,000 annually, and which sum represents about 43 per cent of the entire export trade of Russia. Shipments of grain, ore, coal and petroleum were stopped. The grain trade was severely affected, the loss caused at Odessa alone is estimated

at 300,000 roubles with a total loss of one and one-half million roubles. This grain was consigned to Italy, southern France, Switzerland, Belgium, England, and western Germany. The delayed exportation of coal was very serious, this trade had only recently been developed on the Don, and was urgently needed because of the coal strikes in England.

At the end of April 20 freight steamers were obliged to wait in the Black Sea ports with four passenger steamers of the Russian Steamship Company, one steamer of the Russian volunteer fleet, and 15 sailing ships. Six passenger steamers and one freight steamer were prevented from entering at this date. During the middle of May there were about 150 steamers laden with grain, coal, ore, naphtha, lumber, etc., laid up in the Russian Black Sea ports waiting for passage through the Dardanelles.

The expense incurred by each of these vessels amounted to between 200 and 400 roubles daily.

The Turkish government replied to the Russian protest that the Dardanelles could not be opened as long as the Italian naval vessels were in the vicinity, but at the beginning of May they yielded to the pressure of the powers, and after long delays finally reopened the Dardanelles on May 19.

Sixty mines had to be removed from the mine fields in the Straits of Dardanelles before it would be safe for vessels to attempt to pass. These mines were removed with great difficulty and required ten working days to clear a channel. One of the mine laying vessels, the tug *Semendar,* was blown up while working with the mines in the Dardanelles. Eight civilian employees and 15 military persons were drowned by this accident.

The passenger steamer *Texas* of the American Archipelago line struck a mine in going out of the harbor of Smyrna, and the explosion of the mine caused the ship to sink so rapidly that only one-half of the people on board were rescued by boats from vessels that immediately went to her assistance.

The Italians then decided to continue pressure upon Turkey by seizing the other islands in the Aegean Sea, especially the island of Rhodes.

This island is about ten miles from the coast of Asia Minor. It had 26,000 inhabitants including 17,000 Greeks. The Turkish garrison consisted of about 1000 infantry and artillery. This

garrison was strengthened by a landwehr force of 10,000 native Mahomedans. Stores of provisions and ammunition magazines were in the interior of the island. Major Abdullah had command of the Turks.

The Italian expeditionary army for the conquest of Rhodes consisted of about 9000 troops, three regiments of infantry, of which two were sent from Benghasi and one from Tobruk; one battalion of chasseurs that had been stationed at Tripoli with several small detachments of light field artillery, cavalry, sanitary detachments and train. The latter including a balloon park and aviation apparatus. Lieutenant-General Ameglio, recently promoted for his distinguished services at Benghasi, was in command of the expeditionary army.

The first and third divisions of the fleet were designated to cooperate with the army expeditionary corps in taking possession of Rhodes. The first division under the command of Vice-Admiral Viale left Tarento, April 30, for Rhodes via the provisional base at Astropalia. A number of transports were assembled at Tobruk with the third division of the fleet and flotillas of torpedo boats to convoy the expeditionary army. The waters in the vicinity of the island of Rhodes were in the meanwhile patrolled by torpedo boats, and a considerable number of Turkish sailing vessels were seized as prizes. On May 1 they cut the cable from Rhodes, Scarpanto, and Candia, so that Rhodes was thereafter without cable communication with the mainland. Turkish reports were transmitted by means of signals, but this method of communication was frequently interrupted, especially at night by the Italian searchlights.

The Italian army convoyed by the third division, under the command of Vice-Admiral Amero, left Tobruk at noon May 2, and arrived off the city of Rhodes during the night of May 4.

While the vessels of the first and third divisions made a demonstration against the city, the transports, accompanied by torpedo boats went to Kalithea Bay, ten miles south of the city, on the east coast of the island. The troops were landed May 4 between 4 a. m., and 2 p. m., without opposition, and at 2 p. m. began to advance upon the city overland from the southward. A light detachment of Turkish troops that had left the city at noon to oppose the invaders were met on Smith Plateau and quickly dispersed,

while at the same time they were exposed to a bombardment by 11 Italian ships.

The Italian troops halted about 2 kilometers from the city at 7 p. m., and passed the night in that position. The Italian warships displayed their searchlights on the city during the entire night. The losses during the skirmishes with the advancing army were very slight. The Italians officially reported seven wounded. During the night the Turkish troops withdrew in small detachments to the west coast of the island via Trianda.

As soon as the troops had landed at Kalithea Bay Vice-Admiral Viale sent an officer to the Wali of Rhodes and demanded a surrender of the island. The Wali declared he could not resist the admiral and had no authority over the Turkish garrison; and he therefore declined under protest. The Admiral again demanded the surrender of the city the next morning with an ultimatum that if not granted within one hour he would proceed to bombard the city. The representative of the Turkish government thereupon yielded, and the Italian army and navy took possession at 10 a. m., May 5.

The Wali of Rhodes—who was also governor of the entire archipelago from Tenedos to Scarpanto was captured on May 7 in the harbor of Lindos by the Italian destroyer *Ostro* as he, with other Turkish officials, was about to leave the island. He and his companions, together with 117 other Turkish prisoners were sent to Tarento May 11.

The Turkish garrison was prevented from escaping from the island by the watchfulness of the Italian torpedo boats, and they rendezvoused in the vicinity of Pithos, a region hemmed in by a mountain range that crosses the island, and at about 18 kilometers southwest of the city.

May 15 General Ameglio took the offensive against the Turks at Psithos. He led troops from two regiments from the northeast and east towards Psithos. Italian troops were landed from the naval vessels at Kalavarda 30 kilometers southwest of Rhodes, and at Malona Bay, 33 kilometers south of Rhodes.

The Turks were thus attacked from three different sides while the battleship *St. Bon* bombarded the only other available road of escape by firing over the hills.

A desperate battle that lasted nine hours was fought by which the Turks were dispersed leaving 83 dead and 26 wounded among the ravines of the hills. The Italians took possession of Psithos and passed the night there. The next morning the Turkish commander surrendered. The Turkish garrison of 983 men, including 33 officers, were prisoners of war. In view of their distinguished bravery the Turkish officers were permitted to retain their swords. The bulk of the Italian forces then returned to the city of Rhodes. The Italians officially reported a total loss during the fight of May 16 as only 4 dead and 26 wounded.

The island of Rhodes was declared to be blockaded with the exception of the port of the city of Rhodes, commerce with which could be maintained under the surveillance of Italian authorities.

The former Italian consul at Salonica, Bivalda, was appointed governor of Rhodes.

In the period from May 8 to May 20 the vessels of the first division took possession of the small islands of the Aegean Archipelago between Crete, Rhodes, and Samos. They hoisted the Italian flag over these islands and made prisoners of all Turkish officials and the small Turkish garrisons they found on these islands.

Among others these islands are: Kaltria, Carpantos, Kasos, Episcopi, Nysiros, Kalimnos, Leros, Patmos, Kos, and Smyni. These islands were captured without bloodshed. All officials and military personnel were conveyed as prisoners to Italy.

May 18 the *Regina Margherita* bombarded the small Asia Minor port Marmarice, opposite Rhodes, where Turks had assembled and established a depot.

The continued presence of the Italian warships in the Aegean Sea, and threats published in Italian papers that Italy would take possession of other larger islands, induced the Turkish government to reinforce those islands and complete their defences. All persons who could not participate in the defence of these islands were removed to the mainland, and additional troops were sent to reinforce the garrisons. Mytilene which had a garrison of 3000 received a reinforcement of 2000 troops who were conveyed thither in small detachments by small boats from Aivali. The garrison of Chios was in like manner reinforced by several thousand troops.

The ports in Syria: Beirut, Mersina, Acre, Jaffe and Haida were reinforced and fortified.

May 20 the Turkish government decreed the banishment of all Italians from Turkish dominions; about 50,000 persons, 12,000 of whom were in Constantinople. The decree excepted clericals, widows, cripples and laborers (about 2000 men), and required all others to leave within 14 days.

The decree of banishment was handed to the German ambassador, representing the Italian government in Constantinople, on May 22. This decree was based upon the manner in which the Italians conducted the war, and especially protested against the Italians for taking Turkish civilian officials as prisoners of war to Italy. It also based its necessity upon the fear of an outbreak by the populace which was much embittered against the Italians for the war and the government was not able to protect Italians residing in Turkey.

A number of Italian ship captains were arrested, as they might serve as pilots for the Italian navy.

The English and French press published protests against the Italian seizure of these 11 islands in the Grecian Archipelago, and claimed that this act materially changed the map of Europe and strengthened the Triple Alliance in the balance of power among the European states. Russia, France and England were weakened by these acquisitions by Italy, and control of the great commercial route through the Mediterranean was passing to Italy and the Triple Alliance.

The press demanded that efforts should be made to stop the war and further encroachments by Italy.

The Italians proceeded to make their possession of these islands secure and permanent. A fortnightly mail service was established from Brindisi via Patras, Pireaus, and Astropalia to Rhodes. The Italian Chamber at the same time established mail steamer service between Italy and North African ports as follows:

Syracuse to Tripoli, three times every week.

Syracuse to Benghasi, twice a week.

Palermo, Trapani, Tripoli, once a week.

Genoa, Sicilian ports and North African ports, once a week, and Venice and North African ports, once a week.

Telegraphic communication was reestablished by radio stations and cables as previously mentioned.

There was no activity of any importance by the navy on the north coast of Tripoli and Cyrenaica during May. The schoolship division and a few ships of the navy cruised on the coast, but on May 25 the schoolship division left Zuara, or rather the new base Sidi-Said, to recruit in Italian home ports.

April 28 the Italian transport *Domenico* with 1275 reservists en route home was stranded on Cape Spartivento, but torpedo boats and other vessels rescued the transport.

ITALIAN MILITARY CAMPAIGN IN TRIPOLI AND CYRENAICA.

During the period from April 15 to May 15, 1912, there were engagements at all the places occupied by the Italians on the coast of Africa, but the Italians held their positions throughout without making any advances in the conquest of the country. The summer opened with intense heat and violent sandstorms. An advance into the interior was not contemplated for this season.

The expeditionary corps that landed at Sidi-Said secured their position on the line to Fort Forwa, also known as Bu Kamesh. The occupation of Sidi-Said temporarily stopped the contraband trade, and the torpedo-boat harbor was completed. A radio telegraph station was erected and regular communication was established with Tripoli by means of dirigible balloons.

The constantly increasing Turkish-Arabian forces, which were well supplied with artillery, opposed the Italians all along the coast. Major Fethi Bey, formerly Turkish military attaché at Paris, was in supreme command of the Turkish-Arabian forces. There were many desperate attacks by the Turks which were invariably repulsed, but often with great difficulty.

During the latter part of April the Italians made several advances to the southwestward but were compelled to return, and even lost territory they had previously held.

Zuara was still held by the Turks, but the caravan trade was considerably reduced via the Tunisian frontier.

At Tripoli sandstorms caused considerable damage. One aeroplane was destroyed and all the others were damaged, and the Italians barely held their positions. The defences at Tadjura, east of Tripoli, were strengthened.

May 2 the Italians at Homs surprised the Turks and captured the heights southeast of Lebda. The Italians lost four officers and

61 men killed and wounded in this affair, but they repulsed the Turks and have managed to retain this advantageous position which was strongly fortified.

The spirit of the Turkish-Arabian troops was enthusiastic for the war. There were between 300 and 400 trained Turkish officers in the field. They had ample supplies of ammunition and they were not hampered for commissariat. The prospects of the crops were good this year.

(TO BE CONTINUED.)

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON THE DEPARTMENT'S PROPOSED PERSONNEL BILL.

By CAPTAIN H. O. DUNN, U. S. Navy.

The Department's proposed Personnel Bill is a pressing subject which the service should take up seriously and impartially.

The attitude taken by some officers "let well enough alone," assuming the present status is satisfactory, is not well founded. The writer, who has been in touch for some time with the sentiment in Congress, can assure the service that that body does not intend to let the present conditions continue. Economy is the watchword, and it does not require a vivid imagination to see that the present scheme of organization is not economical, nor does it require much thought to foresee where the pruning will take place. The fallacies of "vested interests" and "implied contracts" can be preached *ad infinitum*, but the bald fact remains that our existence depends upon the will of Congress. If the service will study the tables so carefully prepared by the Department entitled "Data as to the Comparative Annual Cost of the Commissioned Personnel of the U. S. Navy and Marine Corps," the economy of the new bill will become apparent.

It is needless to point out the coming "hump" in the junior grade lieutenant's list under the present law. It will not be many years before they will be 40 years old and waiting for promotion.

The question, will the new bill increase the efficiency of the service, should be answered by each officer fairly and honestly, ignoring the attitude "how will it affect me?" and to answer this question it is necessary to read the bill. The Department has sent to each and every officer concerned a copy of the bill together with all the hearings and literature on the subject, so the basis for an opinion is in the hands of the service. It is up to the service to give an intelligent answer, and not a snap judgment.

It is difficult to detach one's personal interest in such a matter and to take the broad ground of the good of the service. There is no doubt that the present status could not be very much improved from a *personal* point of view, where nearly every one who enters has a good chance to be promoted to each grade and retire on the highest pay in flag rank, providing he keeps his digestion and does not strike his superior officer.

If the Pennsylvania Railroad should announce that hereafter all officials from ticket agents up, would be promoted by seniority and all retired into the grade of general manager, no doubt it would please the personnel, but the efficiency of the road would not improve.

Any military service that does not take into account competition will not succeed, or at least attain the degree of success necessary to win battles. Our success in gunnery has been due to competition—let us apply it to the personnel. It is time to recognize the fact that the navy does not exist for the individual, its function is to win battles. The complaint is sometimes made that the bill is too long and complicated. The revised bill has been considerably shortened and simplified, and, considering the large and important field that it covers, it does not seem unduly long. If the average officer would take time to read it carefully the complications would disappear.

Amalgamation is the stumbling block which many officers cannot surmount. A board of experienced officers representing the corps in question went into this subject very thoroughly and decided not only it could be done but also how it could be accomplished. [See Report of Amalgamation Board, December 20, 1911, a copy of which was sent to all officers.]

From a careful study of the subject the difficulties disappear. Surely the successful effort in amalgamating the engineers some years ago points to success. The objection, that officers at present have too many different subjects to master, and to add construction and pay duties would overwhelm them, is entirely unfounded and arises from insufficient knowledge of the plan proposed. It is not the intention of making *all* officers take up *all* specialties. No officer will be *required* to take up any specialty except that of a naval officer. Most of them will of their own accord take up some one specialty. Line officers at present specialize in ordnance, ammunition, electricity, engineering, wireless, submarine, mines,

and torpedoes, and have made notable successes in each. It is proposed to add two more. It should be remembered that the constructors are all graduates of the Naval Academy, and before entering the corps they have about two years sea duty as ensigns. The great gain in amalgamation is flexibility. All hands on board except the doctor and chaplain will be line officers. All will be working for the navy and not for any separate corps. Team work is what wins battles.

Ultimately all line officers will not be constructors or pay officers, but all constructors and pay officers will be sea-going line officers.

The present curriculum of the Naval Academy insures the turning out of good average ensigns—the post graduate courses, recently established, are a fitting corollary to the new personnel bill and can carry out its every measure.

NAVY DEPARTMENT'S PROPOSED BILL TO REGULATE AND INCREASE THE EFFICIENCY OF THE PERSONNEL OF THE UNITED STATES NAVY AND MARINE CORPS.*

(Revised to Date, November 12, 1912.)

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after the passage of this act the numbers of the personnel of the United States Navy on the active list shall be based on the total displacement tonnage, as contained in the official annual Navy Register, of the battleships and cruisers of the Navy that have been authorized by law within twenty-five years; and the personnel for any fiscal year shall be based on such total tonnage existing on January first next preceding said fiscal year: *Provided,* That hereafter the annual estimates for the naval establishment shall contain a list of the battleships and cruisers of the Navy as herein defined, with the displacement tonnage and date of authorization of each of them, together with the total of such tonnage; also a list of the numbers of the enlisted personnel and officers of the Navy and Marine Corps at full strength based on such total tonnage; and until such full strength shall be reached said list shall contain the corresponding estimated numbers for the year

*Discussions by officers of this bill are desired by the Navy Department, and should be submitted direct to the Department.

in question under the operation of this act, said estimated numbers in no case to exceed the full numbers based on the tonnage; and the numbers as enacted into law shall be the authorized numbers for the next ensuing fiscal year.

SEC. 2. That the full strength of the enlisted personnel of the Navy on the active list shall be fixed hereafter on July first of each year at seventy men for every one thousand tons, and fractions in proportion, of the battleships and cruisers of the Navy as ascertained in section one preceding. The authorized numbers for any fiscal year shall be distributed in such ratings as the Secretary of the Navy shall determine, with the approval of the President: *Provided,* That the authorized numbers of such personnel for the fiscal year ending June thirtieth, nineteen hundred and fourteen, shall be fifty-two thousand five hundred.

SEC. 3. That the full strength of the commissioned line officers of the Navy on the active list, excluding officers borne on the Navy list as additional numbers and excluding commissioned warrant officers, shall be fixed hereafter on July first of each year at three such officers for every one thousand tons, and fractions in proportion, of the battleships and cruisers of the Navy as ascertained in section one of this act: *Provided,* That the total authorized number of such commissioned officers shall not hereby be increased more than ten per centum nor decreased more than five per centum in any fiscal year.

SEC. 4. That the total resulting strength of the commissioned line officers of the Navy on the active list on the passage of this act shall be distributed in the several grades in the proportion of one flag officer, four captains, five commanders, thirteen lieutenant commanders, and fifty-five lieutenants, lieutenants (junior grade), and ensigns; and the same proportional distribution shall be followed hereafter in the data for the annual estimates required by section one of this act: *Provided,* That the resulting strength of any of said grades on the passage of this act, and before such proportional distribution, shall not hereby be reduced: *Provided further,* That the authorized strength of the several grades of the line on the active list, exclusive of the Admiral of the Navy, and exclusive of additional numbers, on the passage of this act and for the fiscal year ending June thirtieth, nineteen hundred and fourteen, shall not exceed one admiral, five vice admirals, and twenty rear admirals, one hundred captains, one hundred and thirty-five

commanders, three hundred and fifty lieutenant commanders, and such total number of lieutenants, lieutenants (junior grade), and ensigns as may qualify for said grades under existing law and the provisions of this act.

SEC. 5. That the total number of flag officers, as determined by the provisions of section four preceding shall be distributed in grades in the proportion of one admiral, three vice admirals, and twelve rear admirals. Rear admirals in the upper half of said grade shall receive the pay and allowances now prescribed by law for rear admirals, first nine; and rear admirals in the lower half of said grade shall receive the pay and allowances now prescribed by law for rear admirals, second nine. The President shall appoint the vice admirals, by and with the advice and consent of the Senate, from rear admirals on the active list who have or shall have served creditably as such in command of a fleet, squadron, or division. Similarly, he shall appoint the admirals, by and with the advice and consent of the Senate, from vice admirals on the active list who shall have served creditably as such in command of a fleet, squadron, or division.

SEC. 6. That the annual pay of admirals shall be thirteen thousand five hundred dollars, of vice admirals eleven thousand dollars. The Admiral of the Navy shall be entitled to quarters of twelve rooms, admirals eleven rooms, and vice admirals ten rooms, or in each case commutation therefor at the rate of twelve dollars per room per month, the heat and light allowance to correspond to the allowance of quarters. Admirals and vice admirals shall, on reaching the age of sixty-five years, be retired with three-fourths the pay of their grade. Admirals and vice admirals availing themselves of the privilege of voluntary retirement pursuant to law shall receive the retirement pay of the next lower grade only.

SEC. 7. That after June thirtieth, nineteen hundred and thirteen, there shall be allowed at the Naval Academy one midshipman for each Senator, Representative, and Delegate in Congress, one for Porto Rico, and one for the District of Columbia, and forty at large. The time of admitting successors to the midshipmen at the Naval Academy shall be such as may be established by law from time to time with the object of maintaining the personnel of officers at full strength as provided in this act, and the annual estimates shall recommend, when necessary, such

time as may be suitable: *Provided,* That after June thirtieth, nineteen hundred and thirteen, successors to midshipmen shall be admitted when said midshipmen shall have served two years at the Naval Academy, or, in case of a vacancy in either of said years, then with the next entering class.

SEC. 8. That hereafter midshipmen shall be between the ages of fifteen years and eighteen years on July first of the calendar year of entry. In putting into effect the new ages of entry, the change from the present age limit shall be made as follows: For the current calendar year there shall be no change; subsequently the limits for the first year thereafter shall be fifteen years and nineteen years, and for the second and subsequent years, fifteen years and eighteen years, as required by this act.

SEC. 9. That midshipmen on graduation may be assigned by the Secretary of the Navy to fill vacancies in the lowest commissioned grades of the Corps of Civil Engineers and the Marine Corps: *Provided,* That ensigns may, with the approval of the Secretary of the Navy, be so assigned to said corps on their own application. Graduate midshipmen and ensigns hereafter assigned to the Corps of Civil Engineers shall take rank and precedence in said corps in accordance with the official order of precedence of officers, which order shall not be changed. Graduate midshipmen hereafter assigned to the Marine Corps shall take rank in said corps in accordance with the date of their commission therein, and ensigns hereafter assigned to the Marine Corps shall take rank in said corps, in accordance with the date of commission as ensign of officers of the line of the Navy of the same precedence as said ensigns.

SEC. 10. That ensigns shall serve three years after the completion of the four years' course at the Naval Academy and shall thereafter be promoted in the order of seniority subject to the examination required by law, to the next higher grade after seven years' total service, counting from July first of the calendar year of precedence date. Thereafter officers below flag rank may be promoted at any time, in the order of seniority, to fill a vacancy in the next higher grade; and shall be promoted in such order subject to the examination required by law, after completing periods of total service, counting from July first of the calendar year of precedence date, as herewith enumerated: Lieutenants (junior grade), ten years; lieutenants, eighteen years; lieutenant

commanders, twenty-four years; commanders, twenty-nine years; captains, thirty-seven years: *Provided*, That such promotions shall not cause at the time an excess in the grade of rear admiral of more than fifteen per centum of the authorized number of rear admirals, nor in the grades of captain, commander, and lieutenant commander for the first ten years after the passage of this act, an excess at the time of more than ten per centum of the authorized numbers of said respective grades; nor after ten years an excess at the time of more than fifteen per centum in any of said grades; and said excess in any grade shall be reduced immediately by retirements from the whole grade, as provided in sections twelve and thirteen of this act.

SEC. 11. That the promotions of officers for total length of service, as required by section 10 preceding, shall begin on July first following the passage of this act, and shall continue on the first day of each fiscal year thereafter.

SEC. 12. That when in June of any year there is a prospect that on the ensuing July first there will be a greater number of captains of thirty-seven or more years' total service, counting from July first of the calendar year of precedence date, than will be required to fill the authorized number of flag officers, the Secretary of the Navy shall convene a board of five of the highest ranking available flag officers, and shall place at its disposal the service and medical records on file in the Navy Department of rear admirals and of captains due by such length of service for promotion to the grade of rear admiral. Said board shall then, as soon as practicable on or after said July first, after the promotions and voluntary retirements due on that date shall have been made, select for retirement a sufficient number of rear admirals to reduce the total number of flag officers on said July first to the authorized number of flag officers. Each member of said board shall swear, or affirm, that he will, without prejudice or partiality, and having in view solely the special fitness of officers and the efficiency of the naval service, perform the duties imposed upon him by this act. The finding of the board, which shall be in writing, signed by all the members, not less than four governing and no member to vote on the name of any officer his senior, shall be transmitted to the President, who shall thereupon, by order, make the transfers of such officers to the retired list as are selected by said board; and said retirements shall date as of July first. The redivision of the

rear admirals into upper and lower half shall not take place until said retirements shall have been made. Rear admirals so retired shall receive three-fourths the pay of their grade.

SEC. 13. That when in June of any year there is a prospect that the numbers of captains, commanders, or lieutenant commanders, that will result after the ensuing July first promotions will exceed the authorized numbers of their respective grades, the Secretary of the Navy shall convene a board of five rear admirals, and shall place at its disposal the service and medical records on file in the Navy Department of all the officers in the grades of captain, commander, and lieutenant commander, or due by length of service for promotion to the grade of lieutenant commander. Said board shall then, as soon as practicable on or after said July first, select for retirement a sufficient number of said officers in each grade as it will exist on said July first, after the promotions and voluntary retirements due on that date shall have been made, to reduce the total number of captains, commanders, and lieutenant commanders, on said July first to the authorized numbers of said respective grades. The same procedure in regard to oaths (or affirmation) shall be followed as prescribed in section twelve of this act. The finding of said board, which shall be in writing, signed by all the members, not less than four governing, shall be transmitted to the President, who shall thereupon, by order, make the transfers of such officers to the retired list as are selected by said board; and said retirements shall date as of July first; *Provided,* That officers so retired shall be entitled to a graded rate of pay in accordance with their rank and length of service, as established in section twenty-three of this act for officers retiring voluntarily on their own application, such retirement pay in any case to be not less than the lowest pay there provided for an officer of the same rank of eighteen years' service: *Provided further,* That should the medical record of any officer so retired show evidence of incapacity incident to the service, or physical disability incurred in the line of duty, he shall, if said incapacity or disability be confirmed by a retiring board, and if the recommendation of said board be approved by the President, be retired in accordance with the provisions of sections fourteen hundred and fifty-three and fifteen hundred and eighty-eight, Revised Statutes.

SEC. 14. That the officers constituting the Pay Corps and the Construction Corps of the United States Navy be, and are hereby, transferred to the line of the Navy, and shall be commissioned accordingly.

SEC. 15. That said transfer to the line shall be made in the official order of precedence of officers at date of passage of this act, with rank according to such precedence in the line, or, in case loss of grade, or loss of rank in grade, would result, then to the grade in the line corresponding to such grade, or rank in grade, previous to said transfer, but in any case without change in the official order of precedence; *Provided,* That officers of said corps transferred to the line shall continue to rank with other officers of like grade or rank in the line or in any staff corps in accordance with the official order of precedence, in the same manner as before such transfer: *Provided, however,* That should any officer so transferred to the line have lost precedence on original appointment to the corps from which transferred, he shall, in future, while retaining his grade and present precedence, be entitled to the rank, pay, and allowances of line officers of his original precedence.

SEC. 16. That any officer of the former Pay Corps or the former Construction Corps, after such transfer to the line, may, upon his own application at any time thereafter, be assigned temporarily to the general duties of the line, and if so assigned shall be given a reasonable opportunity to acquire the necessary experience in such line of duties up to and including the duties of the grade he then holds, at the conclusion of which he shall be permanently available for such assignment if he pass the examination provided by law as preliminary to promotion to such grade, failure to pass not to displace such officer from the status for duty occupied by him prior to such temporary assignment: *Provided,* That should any officer so transferred to the line, and who shall have subsequently qualified for the general duties of the line, have lost precedence on original appointment to the corps from which transferred, he shall, after such qualification, resume his former order of precedence, with its corresponding grade and rank, subject to the examination required by law in case of a promotion to a higher grade.

SEC. 17. That officers of the Pay Corps and the Construction Corps transferred to the line in accordance with this act, who

shall not qualify for the general duties of the line in accordance with the preceding section, shall preserve their present status for duty, and shall have all necessary authority over officers and enlisted men for performing said duty: *Provided,* That assistant naval constructors of the rank of lieutenant (junior grade) so transferred shall be available for the general duties of the line.

SEC. 18. That so far as may be consistent with the efficiency of the service the number of selections for retirement, under the requirements of sections twelve and thirteen of this act, from officers of the former Pay Corps and the former construction corps who shall not have qualified for the general duties of the line shall be in any grade in proportion to the number of such officers in that grade.

SEC. 19. That after the passage of this act the duties now performed by officers of the Pay Corps and the Construction Corps of the Navy shall be performed by officers of the line who may be detailed for such duties: *Provided,* That no such detail be made of any officer of the present line who may be above the rank of lieutenant at the date of passage of this act, except temporarily in cases of emergency: *Provided further,* That sections thirteen hundred and eighty-three, thirteen hundred and eighty-four, and thirteen hundred and eighty-five of the Revised Statutes be, and are hereby, repealed.

SEC. 20. That the Chief of the Bureau of Construction and Repair and the Chief of the Bureau of Supplies and Accounts shall be appointed from the list of line officers of the Navy not below the grade of commander, or, in case of officers of the former Construction Corps or the former Pay Corps, not below the grade of lieutenant commander, and who shall be skilled in the duties under cognizance of said respective bureaus.

SEC. 21. That temporarily and until the total length of service of the senior captains shall have been first reduced below thirty-seven years, counting from July first of the calendar year of precedence date, captains of more than thirty-seven years' service, and due by such service for promotion to the grade of rear admiral, if retired on the recommendation of the board as provided in section thirteen of this act, shall be retired with the rank and three-fourths the pay of rear admirals of the lower half; and likewise said captains shall at any time during said temporary restriction, in the discretion and upon the approval of the President,

have the privilege of voluntary retirement on their own application in the same manner as if they had been retired on the recommendation of said board.

SEC. 22. That officers of the Navy of the rank of lieutenant commander and above, in the line or in any staff corps, or officers of the Marine Corps of the rank of captain and above, who may be borne on the list of the Navy and Marine Corps as additional numbers, shall, whenever the best interests of the service require, be subject to retirement on the recommendation of the boards provided in this act, in addition to the numbers recommended in accordance with the requirements thereof; but the average yearly proportion of such retirements shall not exceed the average yearly proportion of retirements of other officers of the same rank and grade who shall be retired on the recommendation of said boards; and said officers shall be retired in all respects in the same manner as other officers of the same rank and grade as provided in this act.

SEC. 23. That when the interest of the service shall permit it, and in the discretion and upon the approval of the President, an officer of the Navy or Marine Corps of more than eighteen years' total service, including service in the Regular or Volunteer Army, Navy, or Marine Corps, may, upon his own application, be retired at a graded rate of pay based on rank and length of service. Such graded pay shall be, for each completed year of such service, a percentage of his pay at date of retirement, as herewith enumerated: Eighteen years, thirty-three per centum; nineteen years, thirty-six per centum; twenty years, thirty-nine per centum; twenty-one years, forty-two per centum; twenty-two years, forty-five per centum; twenty-three years, forty-eight per centum; twenty-four years, fifty-one per centum; twenty-five years, fifty-four per centum; twenty-six years, fifty-eight per centum; twenty-seven years, sixty-two per centum; twenty-eight years, sixty-six per centum; twenty-nine years, seventy per centum; thirty or more years, seventy-five per centum: *Provided*, That in determining the service necessary for retirement and the retirement pay, under this section, of officers who have heretofore been appointed or commissioned in the Navy from civil life the credit of five years' service, as prescribed by the act of March third, eighteen hundred and ninety-nine, to reorganize and increase the efficiency of the personnel of the Navy and Marine Corps of the United

States, shall be duly counted in determining the total service of said officers for the purposes of this section; and in determining the service necessary for retirement and the retirement pay, under this section, of officers of the Navy hereafter to be commissioned, and of officers of the Marine Corps heretofore commissioned from civil life or from the ranks, or of officers of said corps hereafter to be commissioned, the total service of said officers shall be determined as in sections twenty-seven and twenty-eight, respectively, of this act: *And provided further* that so much of the act of June 10, 1896, under pay of the Navy reading "and provided further that hereafter no payment shall be made from appropriations made by Congress to any officer of the Navy or Marine Corps on the active or retired list while such officer is employed, after June 30, 1897, by any person or company furnishing naval supplies or war material to the Government: and such payment is hereby made unlawful after such date" is hereby repealed.

SEC. 24. That section fourteen hundred and eighty-one, Revised Statutes, be, and the same hereby is, amended to read:

"SEC. 1481. Staff officers of the Navy or Marine Corps who shall have served faithfully for forty-five years, shall, when retired, have the rank of commodore or brigadier general: and any of said officers who shall be retired at the age of sixty-two years or sixty-four years, before having served for forty-five years, but who shall have served faithfully until retired, shall, on the completion of forty years from their entry into the service, have the rank of commodore or brigadier general: *Provided,* That said staff officers may, for the purposes of this section, count their service from their date of precedence, or in the case of marine officers, may include such credit of service for retirement as is authorized by law: *And provided further,* That nothing in this section shall operate to create any claim for back pay or allowances."

SEC. 25. That hereafter officers of the Navy or Marine Corps before being promoted to the next higher rank, shall be examined for promotion under such rules as shall be prescribed by the President. Any such officer who may be ordered before an examination board, or a retiring board, and in the opinion of said board is not qualified for promotion by reason of professional or mental unfitness, or by reason of incapacity not incident to the service, may, subject to the restriction in the case of officers below the

rank of commander or lieutenant colonel of section fifteen hundred and five, Revised Statutes, as herein amended, on the recommendation of said board, if approved by the President, be retired in his rank at a rate of pay in accordance with his record and length of service, such rate of pay to be stated in the recommendation, but in no case to exceed the graded rate of pay based on rank and length of service as provided in section twenty-three of this act for officers who may retire voluntarily on their own application; or he may be retired on furlough pay, or wholly retired with one year's pay, according to the provisions of section fourteen hundred and fifty-four, Revised Statutes: *Provided,* That if unfit to perform the duties of the place to which it is proposed to promote him, by reason of drunkenness, persistent failure to pay debts, or from any other cause arising from his own misconduct, he shall, in accordance with the provisions of the act of August fifth, eighteen hundred and eighty-two, as hereby amended, be discharged with not more than one year's pay; and this provision shall apply to, and is hereby extended to include, officers of the Marine Corps: *Provided further,* That section fifteen hundred and five, Revised Statutes, be, and hereby is, amended to read:

"SEC. 1505. Any officer of the Navy or Marine Corps on the active list below the rank of commander or lieutenant colonel, who, upon original examination is found not professionally qualified, shall be suspended from promotion for a period of six months from the date of approval of said examination, and shall suffer a loss of numbers equal to the average six months' rate of promotion to the grade for which said officer is undergoing examination during the five fiscal years next preceding the date of the approval of said examination, and upon the termination of said suspension from promotion he shall be reexamined, and in case of his failure upon such reexamination he shall be dropped from the service with not more than one year's pay, unless otherwise recommended by the examining board pursuant to law."

SEC. 26. That sections eight and nine of the act of March third, eighteen hundred and ninety-nine, to reorganize and increase the efficiency of the personnel of the Navy and Marine Corps of the United States (personnel act), be, and hereby are, repealed from the date of passage of this act.

SEC. 27. That the precedence service and service for computation of pay of all officers of the Navy hereafter commissioned

in their first commission shall be the same as that of graduates of the Naval Academy reaching at the same time the same rank as that of said first commission: *Provided,* That the precedence service and service for computation of pay of commissioned warrant officers and warrant officers shall not hereby be reduced, now or hereafter: *And provided further,* That nothing in this section shall be so construed as to change in any way the precedence service or service for computation of pay of any officer in the naval service at the date of passage of this act.

SEC. 28. That the service for computation of pay of all officers of the Marine Corps hereafter commissioned in their first commission shall be the same as that of graduates of the Naval Academy reaching at the same time the same rank as that of said first commission: *Provided,* That the service for computation of pay of officers of the Marine Corps heretofore commissioned from civil life or from the ranks shall be considered to have been four years at date of first commission: *Provided, however,* That the service of any such officer shall not hereby be reduced: *And provided further,* That no back pay shall hereby accrue.

SEC. 29. That nothing in this act shall be so construed as to reduce the rank or grade of any commissioned, warrant, or appointed officer now on the active or retired list of the Navy or Marine Corps; nor to reduce the pay or allowances now authorized by law for any commissioned, warrant, or appointed officer remaining on the active list of the Navy or Marine Corps; nor to increase or reduce the pay or allowances of any commissioned, warrant, or appointed officer now on the retired list of the Navy or Marine Corps.

SEC. 30. That the full strength of the Medical Corps of the United States Navy on the active list, exclusive of the Dental Corps, shall be fixed hereafter on July first of each year at one officer of said corps for each two thousand tons, and fractions in proportion of the battleships and cruisers of the Navy as ascertained in section one of this act: *Provided,* That the present authorized strength of the Medical Corps shall not hereby be reduced: *Provided further,* That the total authorized strength of said corps shall not hereby be increased more than ten per centum nor decreased more than five per centum in any fiscal year: *And provided further,* That the authorized strength of the Medical Corps on the active list, exclusive of the Dental Corps, for the fiscal

year ending June thirtieth, nineteen hundred and fourteen, shall be three hundred and forty-five.

SEC. 31. That on the passage of this act the active list of the Medical Corps shall be arranged in the several grades of medical director with the rank of captain, medical inspector with the rank of commander, surgeon with the rank of lieutenant commander, passed assistant surgeon with the rank of lieutenant, and assistant surgeon with the rank of lieutenant (junior grade), in such manner that officers of said corps shall have the same rank, so far as authorized for the Medical Corps, and as specified in this section, as line officers of the same precedence; and thereafter officers of the Medical Corps shall be promoted to the next higher of said grades when the line officer with whom or next after whom they take precedence is promoted to the corresponding grade in the line.

SEC. 32. That no person shall be appointed assistant surgeon in the Navy until he shall have been examined and found qualified by a board of medical officers, designated by the Secretary of the Navy, and under such rules as the Secretary of the Navy shall prescribe, nor who is at the time of such appointment less than twenty-two or more than thirty years of age; and assistant surgeons commissioned on the same date shall take rank in their order of merit as determined at the date of examination for said appointment.

SEC. 33. That when in June of any year there is a prospect that the numbers resulting in the several grades of the Medical Corps after the ensuing July first promotions in accordance with the provisions of sections ten and thirty-one of this act will exceed in the grade of medical director five sixty-fifths, in the grade of medical inspector five sixty-fifths, or in the grade of surgeon thirteen sixty-fifths of the full strength of the Medical Corps, excluding the Dental Corps, the Secretary of the Navy shall convene a board composed of two flag officers and the three highest ranking available medical directors, and shall place at its disposal the service and medical records on file in the Navy Department of all the officers in the grades of medical director, medical inspector, and surgeon, or due by length of service for promotion to the grade of surgeon. Said board shall then, as soon as practicable on or after said July first, select for retirement, no member to vote on the name of any officer his senior, a sufficient number

of said officers in each grade as it will exist on said July first, after the promotions and voluntary retirements due on that date shall have been made, to reduce the total number of medical directors, medical inspectors, and surgeons on said July first to five sixty-fifths, five sixty-fifths, and thirteen sixty-fifths, respectively, of the full strength of the Medical Corps, excluding the Dental Corps. The same procedure in regard to oaths (or affirmation) shall be followed as prescribed in section twelve of this act, and the finding and action thereon shall be in accordance with the requirements and subject to the provisos of section thirteen of this act: *Provided,* That the number of transfers of such officers to the retired list from any of said grades on July first of any year shall not exceed ten per centum of the actual number in such grade at the time of said transfer.

SEC. 34. That the pay and allowances of officers of the Medical Reserve Corps of the Navy on active duty shall be the same as are now or may hereafter be provided by law for the Medical Reserve Corps of the Army: *Provided further,* That officers of the Medical Reserve Corps who shall apply for appointment in the Medical Corps of the Navy may, upon the recommendation of the Surgeon General, be placed on active duty by the Secretary of the Navy for instruction and further examination to determine their fitness for commission in the Medical Corps.

SEC. 35. That the Hospital Corps of the United States Navy shall consist of chief pharmacists, pharmacists, and enlisted men classed as chief hospital stewards, hospital stewards first class, hospital stewards second class, hospital stewards third class, and hospital apprentices, corresponding, respectively, to the enlisted ratings of chief petty officer, petty officer first class, petty officer second class, and petty officer third class, and ordinary seaman; that pharmacists shall be appointed by the President, and that vacancies in the grade of pharmacist shall be filled, by selection, from the enlisted force of the Hospital Corps of the United States Navy, subject to such examination as the Secretary of the Navy shall prescribe; that the pay, allowances, and emoluments of the enlisted men of the Hospital Corps shall be the same as are now or may hereafter be allowed by law for respective corresponding ratings in the seaman branch: *Provided,* That the pay of the rating of chief hospital steward shall not be reduced below that allowed by existing law for hospital steward.

SEC. 36. That the full strength of the Corps of Chaplains of the United States Navy on the active list shall be fixed hereafter on July first of each year at one officer of said corps for each twenty thousand tons, and fractions in proportion, of the battleships and cruisers of the Navy as ascertained in section one of this act: *Provided*, That the present authorized strength of the Corps of Chaplains shall not hereby be reduced: *Provided further*, That the total authorized strength of said corps shall not hereby be increased more than ten per centum nor decreased more than five per centum in any fiscal year: *And provided further*, That the authorized strength of the Corps of Chaplains for the fiscal year ending June thirtieth, nineteen hundred and fourteen, shall be twenty-six.

SEC. 37. That chaplains shall be eligible to promotion to the next higher rank when they shall have served three years in the rank of lieutenant (junior grade) and eleven years in the ranks of lieutenant (junior grade) and lieutenant combined: *Provided*, That chaplains may be promoted at any time to fill a vacancy in the next higher rank: *And provided further*, That before appointment to or promotion in rank in the Corps of Chaplains they shall pass such examinations as the Secretary of the Navy shall prescribe.

SEC. 38. That the Corps of Professors of Mathematics of the United States Navy on the active list shall consist hereafter of twelve officers, of whom three shall be professors of mathematics with the rank of captain; four professors of mathematics with the rank of commander; and five, professors of mathematics with the rank of lieutenant commander: *Provided*, That appointees to said corps shall be not less than thirty nor more than forty years of age at the time of such appointment: *Provided further*, That before appointment to or promotion in rank in said corps they shall pass such examinations as the Secretary of the Navy shall prescribe: *And provided further*, That section fifteen hundred and twenty-eight, Revised Statutes, be, and the same is hereby, repealed.

SEC. 39. That the full strength of the Corps of Civil Engineers of the United States Navy on the active list shall be fixed hereafter on July first of each year at one officer of said corps for each twenty thousand tons, and fractions in proportion, of the battleships and cruisers of the Navy as ascertained in section one of this

act: *Provided,* That the present authorized strength of the Corps of Civil Engineers shall not hereby be reduced: *Provided further,* That the total authorized strength of said corps shall not hereby be increased more than ten per centum nor decreased more than five per centum in any fiscal year: *And provided further,* That the authorized strength of the Corps of Civil Engineers for the fiscal year ending June thirtieth, nineteen hundred and fourteen, shall be forty-four.

SEC. 40. That hereafter the Corps of Civil Engineers shall comprise civil engineers with the rank of captain, commander, and lieutenant commander, assistant civil engineers with the rank of lieutenant, lieutenant (junior grade), and ensign, and acting assistant civil engineers with the rank of ensign. On the passage of this act the active list of said corps shall be arranged in the several grades and ranks in such manner that officers of said corps shall have the same rank, so far as authorized for the Corps of Civil Engineers, and as specified in this section, as line officers of the same precedence; and thereafter officers of the Corps of Civil Engineers shall be promoted to the next higher of said ranks, with the corresponding grade, when the line officer with whom or next after whom they take precedence is promoted to the corresponding grade in the line: *Provided,* That no officer shall be promoted in the rank in the Corps of Civil Engineers until he shall have passed such examinations as the Secretary of the Navy shall prescribe.

SEC. 41. That hereafter appointments to the Corps of Civil Engineers, except the appointments thereto of graduate midshipmen and ensigns, as provided in section nine of this act, shall be made only after such prospective appointees shall have served a probationary period of two years, as nearly as may be practicable, as acting assistant civil engineer, which grade is hereby authorized and established. Candidates for appointment to said grade shall be graduates of a school of civil engineering of good standing, shall qualify in a competitive professional examination before a board of officers of said corps designated by the Secretary of the Navy, and under such rules as the Secretary of the Navy shall prescribe, and shall be between the ages of twenty-one and twenty-six years at the time of such appointment, which shall be made by and shall be revocable at the will of the Secretary of the Navy, and shall otherwise be subject to existing law for appointments

to the Corps of Civil Engineers; and the rank, pay, and allowances of acting assistant civil engineers shall be the same as for ensigns; and said acting assistant civil engineers shall be subject to the laws governing pensions, gratuities, and other benefits in the naval service, but shall not be entitled to retirement or retirement pay. Said probationary period shall end two years from July first of the calendar year of original entry, and the number of appointments to said grade to be made in any calendar year shall be the number required to fill existing vacancies and prospective vacancies by operation of law in the authorized strength of said corps in the same calendar year: *Provided*, That graduate midshipmen and ensigns who may qualify under existing law for appointment to the Corps of Civil Engineers and shall be assigned to said corps shall be commissioned assistant civil engineers with the rank of ensign, and shall take rank and precedence in said corps in accordance with the official order of precedence of officers, which order shall not be changed. Upon the completion of the probationary period, as herein prescribed, acting assistant civil engineers shall, if qualified, be commissioned assistant civil engineers with the rank of lieutenant (junior grade), in the order of merit as determined by their probationary service, and under such rules as the Secretary of the Navy shall prescribe.

SEC. 42. That when in June of any year there is a prospect that the numbers resulting in the grade of civil engineer in the ranks of captain and commander after the ensuing July first promotions in accordance with the provisions of sections ten and forty of this act will exceed in said ranks combined twenty per centum of the full strength of the Corps of Civil Engineers, the Secretary of the Navy shall convene a board composed of two flag officers and the three highest ranking available civil engineers, and shall place at its disposal the service and medical records on file in the Navy Department of all the officers of the Corps of Civil Engineers in the ranks of captain and commander, or due by length of service for promotion to the rank of commander. Said board shall then, as soon as practicable on or after said July first, select for retirement, no member to vote on the name of any officer his senior, a sufficient number of said officers in said ranks as they will exist on said July first, after the promotions and voluntary retirements due on that date shall have been made, to reduce the total number of civil engineers of the ranks of captain and commander com-

bined on said July first to said twenty per centum of the full strength of the Corps of Civil Engineers. The same procedure in regard to oaths (or affirmation) shall be followed as prescribed in section twelve of this act, and the finding and action thereon shall be in accordance with the requirements and subject to the provisos of section thirteen of this act: *Provided,* That the combined number of transfers of such officers to the retired list from said ranks of captain and commander on July first of any year shall not exceed ten per centum of the actual number in said ranks combined at the time of said transfer.

SEC. 43. That two officers not below the rank of lieutenant commander shall be detailed as assistants to each of the bureaus of the Navy Department, and, in case of the death, resignation, retirement, completion of term of appointment, absence, or sickness of the chief of the bureau, shall, in order of rank, unless otherwise directed by the President, as provided by section one hundred and seventy-nine of the Revised Statutes, perform the duties of such chief until his successor is appointed or such absence or sickness shall cease.

SEC. 44. That warrant officers in grades as authorized by present law and this act, including electricians, which grade is hereby authorized and established, may be appointed by the President as may be necessary for the naval service not to exceed twenty in the same grade in any fiscal year. Electricians shall be eligible for appointment as chief electricians after six years from date of warrant, and the rank, pay, and allowances in the several grades of warrant officers and commissioned warrant officers shall be the same as now provided by law for boatswains and chief boatswains, respectively, and the allowances shall include also heat and light allowances to correspond to the allowance of quarters: *Provided,* That all warrant officers shall be examined for promotion by such examining boards as the Secretary of the Navy shall designate: *Provided further,* That chief carpenters and carpenters and chief electricians and electricians shall be eligible for appointment to the grade of ensign under the restrictions imposed by law upon the appointment to that grade of other commissioned warrant officers and warrant officers: *And provided further,* That chief boatswains, chief gunners, chief machinists, chief carpenters, and chief electricians, not to exceed a total at any time of six in each grade, who shall have served zealously,

and who shall pass such examinations as the Secretary of the Navy shall prescribe, may after twenty years from date of warrant be commissioned lieutenants (junior grade) not in the line of promotion; and chief sailmakers and chief pharmacists, not to exceed a total at any time of six in each grade, who shall have served zealously, and who shall pass such examinations as the Secretary of the Navy shall prescribe, may after twenty years from date of warrant be advanced in their respective grades to the rank of lieutenant (junior grade).

SEC. 45. That the full strength of the enlisted personnel of the Marine Corps of the United States on the active list shall be fixed hereafter on July first of each year at a number equivalent to twenty per centum of the full strength of the enlisted personnel of the Navy on the active list for the same year. The authorized numbers for any fiscal year shall be distributed in such noncommissioned and other ranks as the Secretary of the Navy shall determine on the recommendation of the Commandant of the Marine Corps, with the approval of the President: *Provided,* That the present authorized strength of the enlisted personnel of the Marine Corps shall not hereby be reduced: *And provided further,* That the authorized numbers of such enlisted personnel for the fiscal year ending June thirtieth, nineteen hundred and fourteen, shall be ten thousand five hundred.

SEC. 46. That the full strength of the commissioned personnel of the Marine Corps, line and staff, on the active list shall be fixed hereafter on July first of each year at forty such officers for each one thousand men, and fractions in proportion, of the full strength of the enlisted personnel of said corps on the active list; and the number of commissioned officers of the staff departments of the Marine Corps on the active list shall be seven and one-half per centum, to the nearest whole number, of the total of said commissioned personnel: *Provided,* That acting second lieutenants shall be counted in the total of said commissioned personnel: *Provided further,* That the present authorized strength of said total personnel shall not hereby be reduced: *And provided further,* That the authorized strength of said commissioned personnel of the Marine Corps shall not hereby be increased more than ten per centum nor decreased more than five per centum in any fiscal year.

SEC. 47. That on the passage of this act the authorized strength of the line of the Marine Corps on the active list shall be distributed in the several grades in the proportion of one general officer, four colonels, five lieutenant colonels, thirteen majors, fifty-two captains, and one hundred and ten first and second lieutenants and acting second lieutenants; and the same proportional distribution shall be followed hereafter in the data for the annual estimates required by section one of this act: *Provided*, That the authorized strength of the commissioned officers of the Marine Corps, line and staff, on the active list on the passage of this act and for the fiscal year ending June thirtieth, nineteen hundred and fourteen, shall not exceed three hundred and seventy-six, as herewith enumerated: One major general commandant, eight colonels, nine lieutenant colonels, twenty-five majors, ninety-eight captains, two hundred and six first and second lieutenants and acting second lieutenants, one adjutant and inspector with the rank of colonel, two assistant adjutants and inspectors, with the rank of lieutenant colonel, three assistant adjutants and inspectors with the rank of major, one quartermaster with the rank of colonel, two assistant quartermasters with the rank of lieutenant colonel, three assistant quartermasters with the rank of major, eleven assistant quartermasters with the rank of captain, one paymaster with the rank of colonel, one assistant paymaster with the rank of lieutenant colonel, two assistant paymasters with the rank of major, and two assistant paymasters with the rank of captain.

SEC. 48. That hereafter appointments to the Marine Corps, except the appointment thereto of graduate midshipmen and ensigns, who shall take rank as provided in section nine of this act, shall be made only after such prospective appointees shall have served a probationary period of two years, as nearly as may be practicable, as acting second lieutenant, which grade is hereby authorized and established. Candidates for appointment to such grade shall be between the ages of nineteen and twenty-three years at the time of such appointment; which shall be made by and shall be revocable at the will of the Secretary of the Navy, and shall otherwise be subject to existing law for appointments to the Marine Corps; and the rank, pay, and allowances of acting second lieutenants shall be the same as for second lieutenants; and said acting second lieutenants shall be subject to the laws governing pensions, gratuities, and other benefits in the Marine Corps, but

shall not be entitled to retirement or retirement pay. Said probationary period shall end two years from July first of the calendar year of original entry, and the number of appointments to said grade to be made in any calendar year shall be the number required to fill existing vacancies and prospective vacancies by operation of law in the authorized strength of the commissioned personnel of said corps in the same calendar year.

SEC. 49. That upon the completion of the probationary service as prescribed in section forty-eight preceding, acting second lieutenants shall, if qualified, be commissioned second lieutenants in the order of merit as determined by their probationary service, and under such rules as the Secretary of the Navy shall prescribe; and such commissions shall date from July first of the calendar year of appointment as acting second lieutenant, but shall not carry any claim for back pay. Officers not so commissioned shall be honorably discharged from the service. Second lieutenants, after three years' total service from date of first commission, shall, if qualified, be promoted to the grade of first lieutenant. Thereafter officers of the line of the Marine Corps may be promoted at any time, in the order of seniority, to fill a vacancy in the next higher grade, and shall be promoted, subject to the examination required by law, after completing periods of total service, counting from July first of the calendar year of date of first commission, as herewith enumerated: First lieutenants, ten years; captains, eighteen years; majors, twenty-four years; lieutenant colonels, thirty years: *Provided,* That officers who shall have gained or lost numbers shall be considered to have gained or lost service accordingly: *And provided further,* That such promotions, for the first ten years after the passage of this act, shall not cause at any time an excess in any grade of more than ten per centum of the authorized numbers in such grade; nor after ten years an excess at the time of more than fifteen per centum in any grade; and said excess shall be reduced immediately by retirements from the whole grade, as provided in section fifty-two of this act.

SEC. 50. That the numbers in the several grades of the Marine Corps determined by the requirements of this act on July first of any year shall obtain throughout the fiscal year, and vacancies occurring during the year shall, subject to the provisions of section forty-nine preceding regarding the promotion of acting second lieutenants, be filled in order of seniority from the grade below.

SEC. 51. That the general officers required by section forty-seven of this act shall be selected by the President from the colonels or lieutenant colonels of the line on the active list. The general officers other than the commandant shall have the rank of brigadier general. Hereafter, when a vacancy shall occur in the office of major general commandant of the Marine Corps, the President shall appoint to such vacancy, by and with the advice and consent of the Senate, an officer of the Marine Corps on the active list not below the rank of lieutenant colonel, who shall hold office as such major general commandant for a term of four years, but such appointment shall not create a vacancy in the grade from which such officer may be appointed or to which he may be promoted during the period of such appointment: *Provided*, That any officer who shall be retired from active service while holding the office of major general commandant, or who shall have served a full term as major general commandant, shall, upon retirement, be retired with the rank, pay, and allowances authorized by law for a major general retired.

SEC. 52. That when in June of any year there is a prospect that the numbers of colonels, lieutenant colonels, majors, or captains of the line of the Marine Corps that will result after the ensuing July first promotions in accordance with the provisions of section forty nine of this act will exceed the authorized numbers of their respective grades, the Secretary of the Navy shall convene a board composed of two flag officers and the three highest ranking available general officers or colonels of the line, and shall place at its disposal the service and medical records on file in the Navy Department of all the officers of the line in the grades of colonel, lieutenant colonel, major, and captain, or due by length of service for promotion to the grade of captain. Said board shall then, as soon as practicable on or after said July first, select for retirement, no member to vote on the name of any officer his senior, a sufficient number of said officers in each grade as it will exist on said July first, after the promotions and voluntary retirements due on that date shall have been made, to reduce the total number of colonels, lieutenant colonels, majors, and captains of the line on said July first to the authorized numbers of said respective grades. The same procedure in regard to oaths (or affirmation) shall be followed as prescribed in section twelve of this act, and the finding

and action thereon shall be in accordance with the requirements and subject to the provisos of section thirteen of this act.

SEC. 53. That the total authorized strength of the staff departments as required by section forty-six of this act shall be assigned in the ratio, to the nearest whole number, as nearly as may be practicable, of twenty per centum to the Adjutant and Inspector's Department, and fifty-five per centum to the Quartermaster's Department, and twenty-five per centum to the Paymaster's Department. The distribution in grades in each department shall be in the same proportions, to the nearest whole number, as nearly as may be practicable, as required for the line by section forty-seven of this act, down to and including majors, with the addition in the Quartermaster's Department of three captains for every major of the authorized proportion, and in the Paymaster's Department two captains for every major of said authorized proportion: *Provided,* That the proportion assigned to general officers in the line shall be included with that of colonels in the line in determining the number of colonels in the staff department.

SEC. 54. That the provisions of this act relating to compulsory retirement of officers in excess in any grade, except for age or disability, shall not apply in time of war or threatened war.

SEC. 55. That all acts and parts of acts, so far as they conflict with the provisions of this act, be, and the same are hereby, repealed.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

CONSIDERATION OF THE CALIBER OF THE MAIN BATTERY OF BATTLESHIPS.

By D. José Maria Cervera, Captain of Artillery, Spanish Navy,

Translated by Lieut.-Commander Stephen V. Graham, U. S. Navy, from *Revista General de Marina.*

The selection of the gun that is to form the main battery of a battleship is a problem that is to be solved by the artillerist, the sea-going officer, and the naval constructor, since these three occupy different points of view which it is neccessary to embrace and harmonize, in order to arrive at the correct solution.

At the present moment there exists a strong current of opinion in favor of an increase of caliber, as shown in the armament of the most recent ships of the principal naval powers.

England initiated the movement, for, while the *Dreadnought* mounted 12-inch guns of 45 calibers in length, and the *St. Vincent* 12-inch of 50 calibers in length, the *Orion* class will carry 13.5-inch guns of 45 calibers in length.

In the United States the same course has been followed, and, while the 14-inch guns of 45 calibers form the main battery of the *New York* and the *Texas*, it is said that a 16-inch naval gun is in the experimental stage.

Germany, for her part, has advanced rapidly from 11 to 12 and 14 inches.

As is seen, all of the powers are increasing the caliber of their heavy guns, and the 13.5-inch gun appears to be giving place to the 15-inch and 16-inch gun. Nevertheless, some naval authorities indicate the probability and desirability of the return to more moderate calibers, or, at least, experience some doubt as to the maximum efficiency to be obtained in naval vessels by the use of such exaggerated calibers. Even Brassey's Annual, so enamored

of English ideas, in its last edition, states that it is not easy to predict the size and power of the gun that will prevail.

It is not, as might appear at the first view, the progress in armor which has primarily necessitated the increase of caliber, for precisely during the time that armor plate has, so to speak, remained stationary, calibers have been increasing.

Discounting the possibility of superior armor to be obtained in the near future, as seems to be indicated by the results of tests of the Simpson plates, there exist other powerful reasons for such increase, which we are going to expose, together with proportionate views of the other side of the question.

We will consider in the first place the penetrating power of the various guns, and, estimating the usual battle ranges to be those comprised between 4000 and 7000 meters, we present the following table from an article read by Count Giraldi, director of the Armstrong factory at Pozzuli, at the first Congress of the Society of the Italian Naval Architects and Marine Engineers, held at Rome, in the middle of last November.

Range	Model 1910 12-inch projectile, wt. 972 lbs., 50 cal.	13.5-inch projectile, wt. 1245 lbs., I. V. 2700 fs., 45 cal.	14-inch projectile, wt. 1566 lbs., I. V. 2500 fs., 45 cal.	15-inch projectile, wt. 1930 lbs., I. V. 2500 fs., 45 cal.	16-inch projectile, wt. 2343 lbs., I. V. 2500 fs., 45 cal.
Yards	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
4364	16.1	17.1	18.15	19.5	21.1
5357	15.4	16.3	17.1	18.6	20.15
6547	13.5	15.3	16.2	17.7	19.3
7638	12.6	14.3	15.35	16.9	18.5

This table shows the thickness of plates of Krupp armor which would be penetrated upon being struck normally by the projectiles of different calibers at ranges between 4000 and 7000 meters, which ranges appear to be the greatest at which it is advisable to fight with armor-piercing projectiles.

Examining the table it is seen that, in some cases, the penetrating power, with relation to the caliber of 12-inch, increases even as much as fifty per cent, and that an effective increase of twenty per cent can be counted upon, which affords a good margin for future armors of resistance superior to the present Krupp plates. And so much more advantage is obtained, if we have, for example, a 12-inch projectile attacking with success under given conditions, a plate of 12 inches in thickness. A 13.5-inch projectile will penetrate with more ease under the same conditions a plate of

13.5 inches thickness, since the penetrating power increases much more rapidly with an increase of caliber than the resistance of a plate increases with analogous increase of thickness. Since the thickness of armor cannot be increased indefinitely, there will always be, using superior calibers, an excess of penetrating power over the resistance of armor.

We have considered only normal impact, which cannot be counted upon in naval actions; and penetration diminishes with the increase of incidence, until it becomes nil, so that, from this point of view, not much greater results would be obtained by attacking with a heavier projectile resulting from an increase of caliber. For this reason, and because present battleships, as well as those under construction, are protected by a belt of 11.8 inches thickness, which can be penetrated by a 12-inch gun, Count Giraldi recommends not increasing caliber beyond this limit.

At present there is a general tendency in all navies to reduce in number the variety of projectiles to be used, pursuing the ideal of arriving at a "single type" which will satisfy all the exigencies of a modern battle; that is to say, which will possess sufficient penetrating power united with greater destructive power by the explosion of its charge.

The French Navy has led in this movement with its *obus alourdi* (weighted shell), designed to combine the effects of an armor-piercing shell of large capacity with walls of sufficient thickness to resist impact, pierce armor of medium thickness, bursting behind it by the action of its large charge and the delayed action fuze with which it is equipped.

The increase of caliber also favors the realization of this ideal by making it practicable for projectiles to carry a large quantity of high explosive, the utility of which was demonstrated by its destructive effect in the Russo-Japanese war.

In fact, the weight of a projectile increases rapidly with the caliber; the weight of the explosive charge and the destructive power increasing consequently in equal proportion. The current technical opinion is that a 12-inch projectile of the approximate weight of 990 lbs. can carry an explosive charge of the weight equal to 3 per cent of the total, that is 29.7 lbs., without losing, on this account, any considerable amount of its power of penetration. It does not appear unreasonable to suppose that a 14-inch projectile, with a weight of 1540 lbs., can carry 3.5 per cent of its

weight, or 54.1 lbs., of explosive. No more does it appear excessive to admit that a 15-inch projectile, with a weight of 1760 lbs., will carry 4 per cent of explosive, that is, 70.4 lbs., and, if it is considered that the high explosive shells (when such are provided in addition to purely armor-piercing shells) carry a bursting charge of 75 per cent of the total weight of the projectile, we have in the case of the 12-inch high explosive shell a bursting charge of 74 lbs., which is practically the weight of the bursting charge of an armor-piercing shell of 15-inch caliber. From this it is seen that with this caliber the ideal of the above-mentioned "single type" of projectile is realized.

In the paper above mentioned, Count Giraldi attempted to prove the contrary, claiming that the armor-piercing shell of to-day carries a bursting charge of 2 per cent of its weight, and that, even if the projectile of the "single type" could increase this to 3.25 per cent, or 3.5 per cent, this limit could not be exceeded; and, therefore, in order to obtain the 74 lbs. of the present 12-inch semi-armor-piercing shell, it would be necessary to increase the caliber to at least 16 inches. For this reason he considers the adoption of a projectile of the "single type" as very doubtful; and when it is further considered that modern high explosives are much more powerful than those of the past, it appears to him unnecessary to increase the caliber above 12 inches, with a length of 45 or 50 calibers. It is true that a projectile from such a gun (12-inch) is capable of destroying the superstructures of an enemy's ship, but it is also true that no vital parts of a ship are situated behind the superstructures.

There are, in addition, other important reasons for advocating an increase of caliber, among which is the very important one of erosion of the bore.

It is true that great effects may be obtained with relatively small calibers, but it is always at the cost of wearing down of the metal and the erosion produced by large charges of nitro-glycerin powders (almost universally used) in spite of the favorable conditions under which these are manufactured at present, the temperature of explosion being reduced by the addition of hydrocarburates. This aspect is very interesting, not only for economic, but also for military reasons, since the erosion suffered by the rifling, and in one word, the bore, diminishes the force of projection and density of loading (by advancing the projectile into

its seat), affecting sensibly the precision of the weapon and diminishing the number of rounds of which it is capable, which might be of grave consequence in a campaign.

Also, since superior caliber provides for a projectile of greater weight, the muzzle velocity may be reduced a given amount and still maintain the same striking energy, and this increases considerably the life of the weapon. However, with these guns the trajectories are less flat than with a gun of 12-inch caliber, which is not desirable in naval gunnery. Consequently, it is advantageous to increase the muzzle velocity in such degree as not to lose advantage of the greater life of the gun and yet obtain a trajectory with a maximum ordinate which will satisfy the necessities of naval combat.

For this reason the 14-inch gun of the United States was given originally an initial velocity of 2580 feet per second, and there is a tendency to increase this to 2680 feet per second.

Another advantage of the larger calibers is the moral effect they impress upon the men who serve them, since they are beyond doubt more impressed with the power of the individual gun they are serving than with the number of guns which their ship carries, and they will be more confident and more certain of victory if they are firing guns that are more powerful than those of the enemy, or, at any rate, those that equal the guns of the enemy. Incidentally it should be mentioned that the ammunition supply is simplified; the direction and control of fire is facilitated; first because the impact of larger shells is more easily seen, and, also, for a given displacement there are fewer guns to control. This has, however, a serious disadvantage, which will be mentioned later.

The advantages and disadvantages of the increase of calibers above 12 inches having been analyzed, we will touch in passing, upon the problem of these most important installations.

We will consider the number of guns that a battleship can mount, taking 20 per cent of the displacement as available for armament. Deducting the 2 per cent necessary for secondary battery, there remain 18 per cent for the principal installations, so that, since the complete weight of the armament of ten guns, including 120 rounds of ammunition for each, amounts to 3250, 3950, and 4750 tons, according as the guns are of 12-inch, 13.5 inch. 14-inch, respectively, we are brought to displacements of 18,000,

22,000, and 26,500 tons, as the case may be. If it were desired, for example, not to exceed 22,000 tons displacement, it would be necessary to renounce mounting 14-inch guns if we wished to install ten large guns.

With the displacement mentioned a ship could carry twelve guns of 12-inch, ten of 13.5-inch, or eight of 14-inch. These figures throw doubt upon the advisability of exceeding a caliber of 12 inches, since the offensive power being thus concentrated in so small a number of pieces (eight if 14-inch caliber be adopted) it is much to be feared that a casualty would disable an important aliquot part of the armament.

As to the type of turret to be selected, double or triple, there are authorities who assign to each gun of 12-inch caliber a weight of 250 tons in the first case, and 150 tons in the second, which shows an important economy of weight amounting to one gun in ten, in case triple turrets are used.

Certain English and Italian publications claim that the saving of weight is even greater.

The triple turret has the further advantage of requiring a less numerous personnel and of simplifying fire control. But it possesses the disadvantage of a greater turning moment when the side guns are fired, and the accumulation of gases.

Italy has been the first nation to launch a battleship carrying triple turrets, but, as Sir William White says, the sanction of this practice depends for proof upon rapidity of loading and firing, and there still remains the risk of disability of a large number of major guns at the same time.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

DISPERSION AND ACCURACY OF FIRE.

By LIEUTENANT BYRON A. LONG, U. S. Navy.

In what way must development tend in order to increase the number of hits at battle ranges?

One frequently hears after a practice: "We straddled the target and would have made a number of hits had the dispersion been less." From others is heard: "Our salvos were beautifully grouped, but they were not on the target. More hits could have been made if dispersion had been greater."

In any analysis of gun fire it is evident that the hitting of a target depends on two factors:

(a) Range error and lateral error;

(b) Dispersion, both vertically and laterally.

For convenience they may be referred to as fire-control errors and dispersion errors.

At target practice an attempt is made to place the mean point of impact of each salvo exactly in the center of the target, but this is impracticable of attainment for obvious reasons, and it is found that the mean point of impact is either short of the target or beyond it. Similarly, the mean point of impact is either to the right or the left of the centre of the target.

On each salvo, therefore, there is a definite range error, and a definite lateral error. The average of these errors for a target practice gives an average range error and an average lateral error for each firing ship.

It is evident, too, that each salvo will be dispersed both vertically and laterally.

These conditions must be fully appreciated; the two kinds of errors (fire-control errors and dispersion errors) occur on every salvo fired, and they embrace every error that exists in the firing of guns.

These two errors vary on each salvo, and are closely associated with each other.

Let us consider first (a) the range error and the lateral error.

If the correct sight-bar range and the correct deflection were known for each salvo, it is evident that hitting would be a maximum when there was no dispersion, vertically or laterally. That is, with known sight-bar range, and known deflection, all dispersion should be wholly eliminated.

The range and deflection are not accurately known, however; they vary from salvo to salvo. The spotter, with the aid of fire-control instruments, attempts to keep the range and deflection accurately, but errors exist on each salvo.

Admitting then that there must be a range error and a lateral error on each salvo, it is important to observe what effect on hitting is caused by dispersion.

(Dispersion is a very loosely used word. So far as concerns gunnery it should be used to indicate the average distance of shots from the mean point of impact; it is the mean vertical dispersion, or the mean lateral dispersion. If it is used to indicate the distance between the outer shots of a salvo, it becomes confusing; furthermore, the distance between the outer shots of a salvo is of little consequence, and has not the mathematical significance conveyed by the term "mean dispersion." Dispersion will therefore be used to indicate mean vertical dispersion, or mean lateral dispersion.)

It will be found that a flat trajectory gun has large horizontal dispersion, but small vertical dispersion. At longer ranges the horizontal dispersion decreases, but the vertical dispersion increases. We are concerned principally with vertical errors, and it avoids confusion and makes the subject much clearer to consider all errors as either vertical or lateral. All horizontal, or range errors are therefore reduced to vertical errors to simplify the problem.

If it were known that on any salvo there would be a definite range error and a definite lateral error, it can be shown mathematically that, neglecting the smaller terms, the greatest possible number of hits would be made when the dispersion of the salvo is:

$$D_v = \tfrac{1}{2}\sqrt{\frac{8.57\,E_v^2 + s^2}{\pi}}$$

$$D_l = \tfrac{1}{2}\sqrt{\frac{8.57\,E_l^2 + w^2}{\pi}}$$

(1) E_v=mean vertical deviation of mean point of impact of salvos (range error) in feet.
(2) E_l=mean lateral deviation of mean point of impact of salvos (lateral error) in feet.
(3) D_v=mean vert. deviation of gun (dispersion) in feet.
(4) D_l=mean lateral deviation of gun (dispersion) in feet.
(5) s=height of target, in feet.
(6) w=width of target, in feet.

For practical purposes the dispersion that produces the greatest number of hits may be taken as 80 per cent of the fire-control errors.

If the dispersion of the salvo is greater or less than the values given, the hits will decrease.

On every salvo there is a range error and a lateral error, and consequently there is a definite dispersion for each salvo that will give the greatest number of hits.

It is evident that the range error and the dispersion are closely associated with each other. Hitting cannot be increased by reducing the dispersion, or increasing it, unless the effect on the range error is considered—but, on the other hand hitting can always be increased by reducing the fire-control error, no matter what the dispersion is. The question is frequently asked, should dispersion be increased or decreased to increase the hitting?

Even supposing that all dispersion could be eliminated, and that all the shots of a salvo fell in a point, it is evident that range errors and lateral errors of considerable magnitude would still exist. We should then be confronted with the fact that having eliminated all dispersion the hitting could actually be increased by introducing dispersion. We may accept as a settled fact, then, that in gunnery a certain amount of dispersion is necessary to produce the greatest number of hits.

There is no doubt that spotting is facilitated if the dispersion is small, and the fire-control error should thereby be reduced. This is a very important point. Were it not for this consideration, it would not be necessary to dwell on dispersion until the practical limits of the fire-control error had been established. Then it could be ascertained whether the existing dispersion should be increased or decreased.

An examination of firings of 8-inch and 12-inch guns of the Atlantic fleet, in the practices of the fall of 1911, and the spring

of 1912, shows that, maintaining the same fire-control errors, the hitting would have been increased by having more dispersion. At a range of 10,000 yards the vertical dispersion should have been increased 15 to 30 per cent, and the lateral dispersion as much in one case as 40 per cent to ensure the maximum hitting with the existing fire-control errors.

It is important to understand this clearly. If the fire-control error had remained unchanged, the dispersion could have been nearly trebled in some cases without decreasing the hits, and an increase of dispersion of 15 to 30 per cent would have actually increased the hitting.

On the other hand, no matter whether the dispersion were large or small, every decrease in the fire-control error would have resulted in a direct increase of hits.

There is no doubt that decreased dispersion will assist the spotter to reduce the fire-control error, but as considerable dispersion will always be present, the probable reduction in the fire-control error due to decreased dispersion cannot be stated. Furthermore, it is important to keep in mind that the spotter is one element only in fire control, and the excellent work of a spotter may be vitiated by the other factors of the fire control. In some systems, too, more dependence is placed on range finders than on spotters, and dispersion would therefore not influence the fire-control errors.

In contemplating the subject one fact stands out apparent—all energy must be devoted to reducing in every way possible the fire-control errors, for no matter what the dispersion, any decrease in range and deflection errors at once increases the hitting. The crying need is for more accurate tracking and better spotting—in short, better fire control.

In order to assist the spotter there should be the least possible dispersion.

When everything possible has been done to reduce fire-control errors, and dispersion has been kept as small as possible, target practice firings will show what range and deflection errors are obtained. These firings will also give the dispersion of salvos, and it will be apparent at once whether the dispersion is too small or too great to ensure the greatest number of hits.

DISCUSSION.

Dispersion and Accuracy of Fire.

REAR-ADMIRAL B. A. FISKE, U. S. Navy.—While it is clear that Lieutenant Long's able article brings out sharply an important but neglected truth, it is equally clear that its effect will be beneficial only in so far as the inference drawn from it is correct.

If the inference drawn be incorrect, the lesson it conveys may be ignored: it may even be perverted to a wrong use.

That an incorrect inference may be drawn by some officers seems probable: in fact it is believed that some officers have actually drawn the incorrect inference that the article teaches that our salvos are bunched too closely.

Of course, the correct inference is that the article teaches that our fire control errors are too great, and should be reduced.

If this inference be drawn, the article will be most beneficial, because everybody will then see the necessity for training men to use the range finder.

CAPTAIN J. H. GLENNON, U. S. Navy.—I think the discussion of this question could be improved by strict adherence to technical terms, the present tendency being to use such terms too loosely. This loose use of words is at first a convenience, but in the last analysis leads to confusion. There is a mathematical theory of errors quite as exact as other mathematics based primarily on the equal probability of committing any given error and its equal in the opposite direction. This premise is only approximately true with gun fire and especially with errors in the range direction, as will become apparent if we consider that many of the errors are made in small angles at the gun itself; and the effect of a downward angle is not the same in diminishing range as that of an equal upward angle in increasing it; nor have decreases in muzzle velocity the same value in decreasing range as have equal increases in velocity in the opposite direction. The application of the theory of errors then to gun fire can only be approximate. It is or should be presumed that a spotter of any capacity will in the long run have his mean point of impact on the target point of aim.* From this target, then, as projected on the sea along the line of fall of projectiles, equally probable range errors will be practically equal, long or short. The extreme range error, long or short, will be about three times the mean range error (or average of all range errors), and for practical purposes may be taken three

* It may eventually be demonstrated that due to the method of spotting a certain spotter averages a certain amount short or long. This should be applied as a permanent correction to his ranges.

times exactly. The proportion is equally true for any kind of errors—vertical, lateral, radial, or absolute, made by projectiles fired under the existing or any chosen conditions. It is of course not true for wild, tumbling, accidental, or random shots, or for shots fired under conditions of a different kind.

There are a multitude of causes of error in gun fire, but whatever the separate mean errors due to the various causes may be, the most probable value of the combined mean error will be the square root of the sum of the squares of these separate mean errors (following the theory of errors) and the chance of hitting will be diminished according to the same theory as the final mean error is increased. This, it should be understood, is in the long run. One great dispersion may at times accomplish a hit where a short dispersion could not with the same mean point of impact (not the target) for the salvo, but it can work a miss equally well where a short dispersion would get two shots in the target.

A shot-gun is a weapon that fires a great number of projectiles in a short time. Any one of these minor projectiles will suffice for the bird or object ordinarily fired at, and the endeavor is to cover the space in which the bird or object may be. There is no method of correction for successive shots, as it is not possible to determine by sight where most of the shots have gone. Two bodies moving in the same portion of space are the more apt to collide as their sizes or that of either is increased, and in the shot-gun the working size of the projectile, taking all with spaces as one projectile, is increased to a limit where it is considerably greater than that of the target. But if the desire were to hit the bird or object as often as possible with individual projectiles, and if hits could be noted on a larger target around such object, it is sufficiently apparent that a much greater number of hits could be gotten by successive shots with an accurate weapon than by the same number of projectiles fired from a shot-gun; as, for example, by the use of a gallery rifle at a mark on a target at shot-gun ranges. And do the best we can with gun and instruments, due to the outside influences such as fluctuations in atmospheric refraction, in strength of wind, in barometric pressure, with holes in the air, variations in temperature of charge and gun, varying vibratory droops or rises of gun-muzzle, varying spring or jump for different mounts or for the same mount with different training, varying uncompensated vertical angles of axis of elevation of gun, etc., *there will always be relatively to a ship-target more than sufficient similarity to a shot-gun dispersion with even our best salvos.* If we are considering only one salvo or are not going to, or cannot, spot at all, and the range finder is not adjusted to the gun by a known mean correction for the range used and under the prevailing conditions, it would, without doubt, be better to waste a certain amount of ammunition by throwing in an intentional controllable dispersion by simply firing the guns with varying range settings covering the probable range error. This would simulate a good shot-gun, but if continued would make for very primitive target practice. It is a method adapted to an unlimited supply of ammunition and corresponding capacity of weapon to use it, and is especially available for small arms and with the battle conditions of land forces.

The line of advance for larger guns seems always to point in the direction of precision with men, instruments, implements and methods. Controllable dispersion has a value under certain circumstances, not inconsistent with precision in method. But great dispersions, if not worked according to a progressive system with sights set as regularly increasing increments and with guns fired in succession, put the spotter entirely in the air. In short, large gun errors make large spotter errors, and ships that are trying to make records choose every favorable condition, calm, clearness, uniform temperature of magazines, etc., with a view to reducing every mean error due to any of the numerous causes as much as possible, well knowing that their various poor scores have been due to a failure to overcome some one or more of these embarrassing conditions in the past. *Errors, reduce them as we may, are altogether too large, and everything possible should be done to eliminate them.* It is no more necessary to separate the spotter error from the gun error proper than it is to separate the refraction or other types of error, and with the accurate methods of recording now beginning, it may soon be practicable to differentiate the one as well as the others, down to a point where the spotter and the pointer and other persons involved with various causes of error could be intelligently marked as to qualification for the posts they thus occupy, as well, we might add, as could the accuracy of the gun unit itself, in the state at which it has at length arrived through increasing age and use.

LIEUT.-COMMANDER RIDLEY MCLEAN, U. S. Navy.—I find this a most difficult paper to discuss, on account of the fact that it arrives at no final conclusion, which has a practical bearing on gunnery training.

The paper, if read casually, especially by the many young officers in the service who have given the question little thought, might readily be construed into a mathematical demonstration that dispersion in gunnery was a good thing and that in *practical gunnery training* it was not necessary to reduce dispersion to the *minimum limits possible.*

If this academic discussion of the relation between fire control errors and dispersion errors is to have this effect, the paper is pernicious and inimical to practical gunnery training in the navy.

A popular novel a few years ago demonstrated that for certain reasons a certain number of fleas were good for a dog, but still the average dog, despite all possible care, has a sufficient number for the purpose; so also in practical gunnery, I feel that, strive as hard and as intelligently as we may, we shall always find that we have more dispersion than we want, and any treatise or paper, however correct may be its mathematics, which leads the service to regard dispersion with equanimity—in fact which leads us to regard dispersion in any other light than as the very greatest enemy to efficient gunnery—cannot but have a bad effect.

Lieutenant Long concludes that fire control errors must be reduced to the minimum possible, and states that then "it will be apparent at once whether dispersion is too small or too great to insure the greatest number of hits."

Academically this statement is true; practically it is not true, because we can never arrive at a point where we can say that fire control errors have

been reduced to the mathematical minimum. Fire control errors vary so much with the spotters, with the range finders, with the condition of spotting glasses, with atmospheric conditions, and with dispersion itself, that it seems utopian to state that we can ever arrive at such a state of training throughout the service as to justify us in stopping to consider whether or not our dispersion is too small.

This paper states that an examination of the Atlantic fleet records for 1911 and 1912 shows that, maintaining the *same fire control errors*, the hitting would have been increased by increasing the dispersion.

It is presumed that this statement is correct, yet it in no wise follows that dispersion ought to have been greater—it simply proves that fire control errors should have been less.

In deciding whether or not dispersion should ever be increased, let us not be led too far by purely mathematical deductions. Let us rather consider what we are striving to attain. The mathematics of the paper has merely demonstrated that for a given error in fire control, E, there must be a certain dispersion, D, to give the maximum number of hits, but as the paper itself states that all of our energies should be expended to reduce E to zero and when E becomes zero D must also become zero, it would follow that similar efforts should be made to reduce the dispersion error to a minimum.

So much for the mathematics involved. But let us consider an actual target, range 10,000 yards, salvos of seven 12-inch, 2850 f. s. shots being fired at it, and let us disregard all lateral errors and assume that in each salvo the dispersion between different shots is uniform. Certainly the *maximum* results can only be obtained when the shots are well bunched and when the center of impact coincides with the center of the target. A mean vertical dispersion of about 8 feet under such conditions, which would make the salvo cover a zone about 105 yards wide, would land all shots on a target 30 feet high. A mean vertical dispersion of 13 feet, corresponding to a width of zone of about 160 yards would render four, the greatest possible number of hits. A mean dispersion of 26 feet vertically would result in only one hit if center of impact coincided with center of target, two hits if slightly displaced one way or the other.

Two hits would thus be a *maximum possible* score with a mean dispersion of 26 feet, which corresponds to a zone about 312 yards wide; one hit is the maximum possible for any mean vertical dispersion in excess of 50 feet, which corresponds to a zone 625 yards wide.

Under these conditions it doesn't matter within the width of this zone where the target is, it will get one hit and no more, assuming the salvo is correctly aligned. With more than 50 feet mean vertical dispersion the target may be straddled, but you may or may not make a hit.

Now, it is perfectly true that when a material fire control error exists, dispersion is necessary to obtain a hit, which is to say, that a perfectly bunched salvo which for any reason falls short or over, will make no hits at all, whereas if these shots were dispersed sufficiently one or possibly even two hits might be made; also it is perfectly true that with a considerable dispersion, fire control errors within the limits of that dispersion will not affect the score; but it is fallacious to use either of these facts as an argu-

ment in favor of dispersion, for the simple reason that gunnery training must be based on a system which leads to a high score, and a high score with any material dispersion is mathematically impossible.

If we remember that two hits on a 30 foot target is the maximum possible score when the shots are uniformly dispersed through a zone 300 yards wide (which at 10,000 yards range is not in any sense a wide dispersion), and one hit the maximum possible when the shots cover a zone 600 yards wide, and that neither one hit nor even two hits out of a salvo of seven shots can be considered sufficiently high a score to be considered a goal, it follows that every effort should be made to reduce dispersion to the smallest possible limit, and consequently we must reduce our fire control errors so that we can utilize the greatest accuracy of fire that it is possible for us to attain. Any other method is false training.

It may readily be shown that under certain conditions a greater number of hits would have been obtained by increasing the dispersion, *but it can never be shown that a really high score could ever be obtained in that manner.* Dispersion absolutely precludes a high average score, and though it may render a low average almost certain, it must be remembered that low averages won't win battles.

LIEUT.-COMMANDER T. T. CRAVEN, U. S. Navy.—In considering the question under discussion, which involves practical long range firing from a ship, one is impressed with the lack of accurate data on which to base conclusions.

The methods which have been in vogue for ascertaining the amounts by which the targets have been *missed* at target practice, together with the reliability of these data as a basis for precise argument, are probably well understood.

In his discussion of the "Accuracy and Probability of Gun Fire," page 134, Article 140, Exterior Ballistics, the late Professor Alger makes the following statements:

"Evidently the less the mean errors of a gun the more important it is to accurately regulate its fire; if the distance of the mean point of impact from the target is more than three times the mean error of the gun, there will be practically no hits at all.

". . . . Thus we see that a gun may be severely handicapped by its own accuracy if the range is not known within 10 per cent."

The truth of the opening statement contained in the first paragraph requires no elucidation. That in the second paragraph is shown to be correct in the deductions that precede it.

Lieutenant Schuyler aptly closes his well-written notes on this same subject in Volume 37, No. 3, Whole No. 139, of the UNITED STATES NAVAL INSTITUTE PROCEEDINGS, with the statement that ". . . . their importance seems to justify the systematic collection of data and further study."

We have seen the range constantly and rapidly increase within the last few years and this is primarily because the so-called fire control errors have been steadily reduced. The 10 per cent error considered by Professor Alger in 1904, when 5000 yards was thought to be a long range, would be regarded as excessive to-day at double that distance.

There has been a corresponding improvement in all of the methods of long range control and a decrease of the dispersions incident to materiel has also been accomplished.

The advances that have resulted in heavy guns becoming weapons of precision have permitted the successful control of fire at long range. Any improvement in the accuracy of the guns, which results in a further decrease in dispersion, will bring about a corresponding improvement in the facility of control afloat and an increase in hitting power.

The fact that the performance of the gun has directly to do with fire control, and perhaps the establishment of the range, must not be overlooked. While it is manifest that the errors of gun fire are due to a variety of causes, it is also evident that the fire control officer afloat has to deal with the summation of all the parts of which it is composed, *i. e.*, the whole error.

A reduction in any one of the composing parts reduces the whole error and constant, systematic, and continued effort must be directed toward searching out and eliminating such of these parts as may be reduced or eliminated.

With accurate guns, dispersion can be regulated at will. Without accurate weapons as well as accurate instruments and methods of fire control accurate gunnery is impossible.

The author has, after a considerable discussion, arrived at the crux of his argument in the self-evident, well-understood conclusions that—

"In order to assist the spotter there must be the least possible dispersion," and "when everything possible has been done to reduce fire control errors, and dispersion has been kept as small as possible, target practice firing will show what range and deflection errors are obtained. These firings will also give the dispersion of salvos, and it will be apparent at once whether the dispersion is too small or too great to insure the greatest number of hits."

LIEUTENANT W. R. VAN AUKEN, U. S. Navy.—The article by Lieutenant Long on "Dispersion and Accuracy of Fire" is a most timely one. At present, ships are not getting the percentage of hits at long ranges which *are*, and *must* be expected. An *Arkansas* or *Wyoming* not hitting at long ranges is not to be feared by a *Michigan* whose guns are hitting. It is most important now to consider how to increase the hitting efficiency of new ships, for no type of battleship of the largest displacement and guns is superior to older ships in gun fire unless the weight of metal hitting is a fair percentage of that thrown from the firing ship on each broadside.

From results of firing where spotters have controlled the fire, it seems impossible to get the mean point of impact of salvos nearer than 150 yards to the center of danger space. In such salvos, the average mean dispersion was about 50 yards. Now, from a consideration of this article and that by Ensign Schuyler on "Dispersion in Salvos," published in September, 1911, it is granted to be true that the mean vertical dispersion to attain a maximum percentage of hits at any range or target should be equal to 4/5 or 80 per cent of the distance of the mean point of impact from the center of the danger space. If many salvos are fired, where there are vertical dis-

persion and fire control errors it is admitted this relation will hold true. In battle where an enemy's ship is 500 to 600 feet in length, lateral dispersion will cause few, if any, misses. In theory and practice, this mean lateral dispersion is about equal to the mean vertical dispersion at long ranges. So under battle conditions, only mean vertical dispersion need be considered. Hence with the existing fire control error of 150 yards, there should theoretically be about 120 yards mean dispersion to secure the maximum hits. As this is admitted to be at least twice the dispersion that exists now, it is seen that a large percentage of hits are lost.

Though at present, spotters have not materially reduced their errors in controlling salvos of reduced dispersion, the fact remains that we cannot afford to even consider an increase of dispersion beyond that which is brought about by natural and expected gun errors. As dispersion has been reduced somewhat, the fire control efficiency has not kept apace. The materiel seems to be ahead of the fire control training. This reduced dispersion has not as expected reduced the fire control errors.

After reading this article of Lieutenant Long's, one ought not to seriously consider making an increase in dispersion. We cannot afford to be satisfied with the present fire control errors and assume that no improvement can be made at long ranges—through training or by study of the science of gunnery. In bringing about a greater dispersion by any means and working for a scattered salvo in the hope of getting one or two hits by luck, we would convert our modern battery into a large "shot-gun" and sacrifice everything to pure luck. *By all means we should seek for small dispersions and work for reduced errors in control of the fire at long ranges.*

As regards the fire control error it is believed that its principal component is that due to spotting. This statement is based upon the average records of spotters at spotting practice compared with the fire control errors in actual battle practice. This spotting error can be decreased by systematic training and a study of the science of gunnery. It is believed that range finders combined with the spotting will halve the present fire control errors, and with this, a natural mean dispersion of 20 to 30 yards will about agree with the dispersion of theory.

Gun fire at long ranges is based on science, and now, more than ever, all ordnance officers should be conversant with the action of powder, ballistics, probability of hitting and all elements bearing upon the trajectories of projectiles fired at long range. These problems involved in long range control will require deep study and careful investigation. It would seem that a special gunnery ship could be assigned for this duty, and in addition to study carried on aboard, practical experiments could be made at various ranges in spotting, range finding and the limits of long range firing.

It is reasonable to expect that improvement *can* and *will* be made in the control of long range salvos. No haphazard work will bring this about. What is needed is a calibration range, "Gunnery Experts" ship, target practice conducted at long ranges by officers trained on the gunnery ship, a range finder experimental station, and a study of the science of gunnery.

LIEUTENANT G. L. SCHUYLER, U. S. Navy.—It is only comparatively recently that we have begun to awaken to the fact that in view of the im-

possibility of getting the center of impact on the center of the target, what hits we make are not *in spite* of dispersion, but *by virtue* of it. Lieutenant Long's excellent article about winds up the presentation of this side of the argument and it is hoped that familiarity with it and with Ordnance Pamphlet No. 410 will dispel some mistaken ideas on this matter which are only too prevalent in the service at large.

The dispersions now being less than the desired 80 per cent of the fire control errors, those who would further decrease dispersion before fire control errors are further decreased do so with a mathematical certainty that they will, on the average, fare worse than now.

There are in the service many officers who will ignore the entire argument because, on the face of it, it does not seem proper that the pointers who aim most carefully should be poorest rewarded in hitting. In a way, it almost offends our sense of right and wrong to see carelessness apparently rewarded. It should not be, we say. But sentimental reasons will not stand against mathematical ones.

For the benefit of those who would believe it if it all did not sound like such rank heresy and opposed to what they have grown to believe almost religiously, it should be stated that the idea is *not at all* novel in small arm fire at long ranges. Perhaps when they find it a perfectly established and well-recognized fact in small arm fire, they can begin, perhaps grudgingly, to admit there may be something in it after all.

"The Rifle in War," by Captain Eames, U. S. A., is interesting reading in this connection and it is instructive to read of what is called the "combined sight." This means, usually, that the front rank and rear rank set sights at different ranges to increase dispersion, to make it bear a more favorable relation to the probable error in estimating the range of the object. When the dispersion is properly increased more hits are expected. When we get to know of this principle in small arm fire, maybe we can with less distrust listen to those who claim it is just the same with naval guns.

Navy Yard Problems.

(See No. 143.)

ASSISTANT NAVAL CONSTRUCTOR C. A. HARRINGTON, U. S. Navy.—In the September issue of the PROCEEDINGS, Assistant Naval Constructor Otterson has contributed some novel ideas relative to navy yards. It is not understood that the author of "Navy Yard Problems" intended to treat all the problems involved in navy yards, because to do so would require many issues of the PROCEEDINGS rather than some twenty pages of one issue, and would probably take all the rest of Mr. Otterson's life (the latter statement being in no wise intended as a reflection on his ability). He, therefore, perhaps intentionally treated some problems "academically" and ignored others entirely, for which he has been rather harshly criticised. In the minds of some, the chief fault with Mr. Otterson's essay seems to be that he forgot to mention that "navy yards exist for the fleet," a statement which, of course, is quite necessary in any discussion of our navy yards. As the criticisms contained under "Discussion" in PROCEEDINGS No. 143

failed to bring out what appears to the writer to be misstatements and false logic in Mr. Otterson's essay, and as it does not seem quite right that these points should be allowed to pass unchallenged, the following ideas are submitted:

The navy yard problems which are discussed by Mr. Otterson are: (1) a proposed method of treating alterations; (2) the number of navy yards; (3) competition in manufacture among navy yards.

Alterations: The routine suggested by Mr. Otterson is considered advisable for important alterations. If the alteration requested by a single ship is considered of sufficient importance in the discretion of the divisional commander, the matter could be referred to ships of a division and then to ships of the fleet, the result being that if really important, general authority for the change would be issued by the bureau concerned or the department. In this manner, data for future designs would also be on file. It is, however, noteworthy that fully 40 per cent of the items on page 863, these being the most important items also, are alterations which have been authorized in general letters from the bureau concerned. A good many alterations requested by ships are either insignificant in character or of a local nature, which statement is also borne out by a review of the items tabulated on page 863. From these two facts, therefore, it would seem that the items listed by the author fall practically into two classes, namely: (1) those of sufficient importance that the need for the alteration is recognized by the bureau concerned, and general authority is accordingly issued; (2) alterations of local nature or unimportant in character. The routine suggested by Mr. Otterson would, therefore, be necessary on exceptional occasions.

Number of navy yards: Mr. Otterson has ably pointed out the disadvantages of consolidation of navy yards. A single navy yard is operated on the basis that whenever economical and military policies clash, the military policy is retained. The consideration of "sound strategy" and the "pork barrel" and the hunt of the office for the man or vice versa should not be introduced to befog a principle which we use so often these days. One navy yard on the Atlantic Coast would undoubtedly be more economical than five, but as it is obviously an unmilitary policy, as Mr. Otterson proves beyond the shadow of a doubt, why do we advocate it? The policy of carrying "all our eggs in one basket" is not quite as serious as the author makes out, as in time of war repairs to our ships could be effected by private ship yards in addition to our one supposed navy yard. If the repairs to our ships required docking, however, as they probably would, the situation is exactly the one that Mr. Otterson describes, as private yards in this case cannot help us, as only one of the private shipyards on this coast possesses a dry dock.

As an industrial undertaking, the founding of one large yard to do the work of our present yards on the Atlantic Coast is not what might be called a difficult problem in the light of modern engineering. It is easy to conceive that, with our present knowledge, one large plant might be built which would in a comparatively short time pay for itself, provided a proper location were secured. One of the requirements of a proper location is close proximity to a labor market which offers mechanics of all the varied

trades. This requirement positively means the establishment of such a navy yard on this coast in the vicinity of New York, Philadelphia, or Boston. Manufacturing plants frequently build up a city because they offer steady employment. This is not the case with navy yard work, and good mechanics would not build homes and locate their families any place on the shores of Narragansett Bay with the prospect of fluctuating work in a large nearby navy yard. Much more might be said against the establishment of one large navy yard on the Atlantic Coast, but no stronger arguments are needed than those which Mr. Otterson has brought forth.

Distribution of work to our navy yards: The proposal which Mr. Otterson offers bears a striking resemblance to a protective tariff protecting the infant industries. As a matter of fact, Mr. Otterson is pleading for the old method whereby each yard manufactured various articles of equipage in quantities proportional to the demand at that yard, this demand being of course dependent on the number of ships assigned to the yard for repairs, which is the condition recommended by the author (see top of page 872) for determining the factor assignable to each yard to be used in distributing manufacture work. For example, before the manufacture of hammocks was concentrated at certain yards, the New York yard probably manufactured all the hammocks required by ships domiciling at that yard; in the proposed distribution of hammock manufacture, New York would get say 40 per cent of the work on account of the number of ships assigned to the New York yard. There is accordingly nothing new in the proposition.

It does not seem that the author presents any arguments tending to disqualify competition among navy yards in the manufacture of certain articles of equipage; as a matter of fact, it would seem that he has at times jumped to conclusions which are not justified even by assumed premises, namely, when he states at the top of page 871, "so it appears . . . . at a critical time." Such conclusion does not appear to be justified by the statements immediately preceding it.

As to the method or basis of making competitive awards (see page 871), it is understood by the writer that awards are not made wholly on the basis of competitive bids, but that past performances (comparison of returned costs by the bureau involved) are also very largely considered. The writer does not believe that excessively low estimates are intentionally submitted, as each yard knows, if the contract be secured, that it must make good or stand a chance of losing the business.

On pages 872 and 873, the author gives an example of the working of his proposed system and also a hypothetical case of competition. Publishing bulletins containing comparison of returned cost of manufacture and directing investigations would not standardize the efficiencies of the various yards, as there would always be "a least efficient" yard. Some yards have better machinery than others, are better equipped with dies and other expensive labor saving devices. For example, in making drop forgings, would all yards be provided with a set of dies as good as those at Norfolk, or would Norfolk lead in the manufacture of drop forgings and the other yards trail along as best they could?

The competitive system of bidding for manufacturing work has now

been in actual practice some time, and up to date no yard has secured a monopoly of any line of manufacture. The practical result has been that manufacturing work has been distributed, one yard making ditty boxes, another yard boat chests, a third yard boat hooks, etc. Actual conditions, therefore, are quite different from Mr. Otterson's theoretical conditions. There is a great stimulus to this sort of competition, because if a manager at one yard sees, for example, that other yards are getting most of the wood work manufacturing, he knows that there is something wrong with his joiner shop and will proceed to investigate it very thoroughly. The object of every efficient manager is to secure the manufacture of certain articles of equipage which will help him in maintaining his force when there is not sufficient ship repair work. Unfortunately there is not sufficient manufacture work at present so that a steady force can be given employment. There is, however, enough manufacturing at some yards so that the best mechanics may be retained when there is a dearth of ship repair work.

On page 872, Mr. Otterson says that in comparing costs, direct labor is "the true basis of comparison." The true basis of comparison should be the total cost, consisting of labor, indirect, and material. If any other method is used in comparing costs of different yards, a false conclusion is likely to result on account of the following reasons:

(1) Owing to the looseness of the present accounting system, labor which at some yards is charged on the job as "direct labor" is charged at other yards as "indirect." At some yards, for instance, mill work on boats is charged to shop expense and enters into the cost of the boat as "indirect." Therefore, if direct labor only were considered in comparing the costs of boats made at different yards, those yards which charge mill work as indirect would appear to advantage.

(2) The indirect should be considered for the reason given under (1). Also, a number of shops have shop planners whose labor is charged in the overhead expense of the shop. Planning tends to lower the direct labor cost and to increase the "indirect." If "indirect" is not considered, a shop with a large number of planners would undoubtedly show less direct labor cost on a given article than would a shop with a less number of planners.

(3) "Material" cost should be considered because, as Mr. Otterson says, we desire only the "necessary" quality. Some yards would, for example, use a higher grade of pine than was necessary in the manufacture of certain parts of furniture, some yards make breaker stands of ash while others would make them of cheaper beech, birch or maple. Is it fair that a manager who can reduce costs in such a way should fail to receive any reward simply because a comparison of "direct labor" only is to be made? If such were the case, the temptation would be to use only the very best material, as it is a well-known fact that good material reduces direct labor cost.

Comparison of costs on the basis of direct labor would, to say the least, be elusive, as would be also the comparison of estimates based upon direct labor only.

Severe exception may be taken to the author's logic exhibited in the last paragraph on page 878, as there is not the slightest analogy between the best

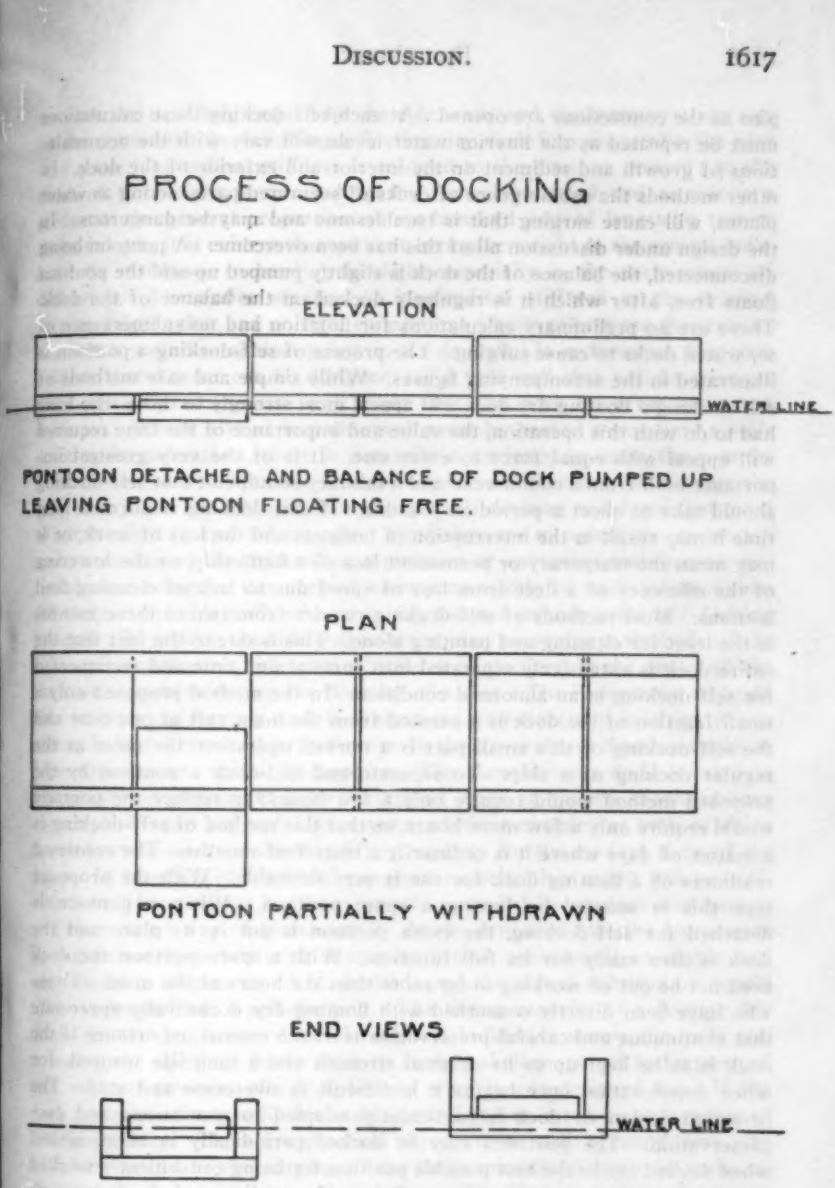
ship at target practice and the best shop at manufacturing. This the author admits, when he says, "It is no more logical to award the work to our navy yards on the competitive basis than to award the allowance of ammunition to our ships on the basis of which made the most hits at the last target practice." The author then proceeds to make the absurd statement that "the ship that makes the most hits this year will do all the firing next year," with the intention, I presume, to have the careless reader think that it is equally absurd that "the shop that does the cheapest work this year will do all the work next year." Suppose we assume a certain similarity between the ship and the shop and endeavor to make a *rational* statement about the former and apply this statement analogously to the latter. We would then say, "The ship that makes the most 6-pdr. hits this year will be excused from firing 6-prds. next year." "The shop that makes the best and cheapest ditty boxes this year will be excused from making ditty boxes next year." The foregoing analogy is certainly as sound as Mr. Otterson's, but both of course are absurd.

Competition among navy yards in manufacturing has resulted in a considerable saving of money on account of the fact that the cost is very greatly decreased. This competition may be greatly extended, so that competition will exist not only among navy yards, but between navy yards and private contractors. The amount of money that can be saved to the government yearly by competition alone is considerable. This will be apparent to any one who investigates the cost of various articles in the custody of the General Storekeeper which have been purchased from outside contractors. We have made a little headway in manufacturing in our navy yards due to competition, but the field is yet practically unexplored. We need fear no loss in efficiency such as Mr. Otterson has described due to competition. From observations of a personal nature, I am of the opinion that what little competition we have had has resulted in increased efficiency in some yards, increased stimulation on the part of those in charge, better designs, and better quality of articles manufactured. In certain lines of manufacture, it is found cheaper to keep machines and mills operating, even though the product is sold at a loss, rather than to shut down entirely. In the navy, we do the opposite thing; that is, we shut down a shop or, practically the same thing, run it on very much reduced capacity at the slightest provocation. Why? The answer partly is that we have not yet made a dent in navy yard manufacturing. The subject of navy yard manufacturing and competition therein is worthy of minute and exhaustive study.

An Improvement in Floating Dry Docks.

(See Nos. 142 and 143.)

CIVIL ENGINEER A. C. CUNNINGHAM, U. S. Navy.—*A Review of Preceding Discussions.*—Those who have had to do with the self-docking of floating dry docks will most fully appreciate the importance of simple and safe methods. In some methods careful calculations must be made beforehand of the flotation of the separated parts, and the interior water levels must be adjusted accordingly in order that there may be no shearing of bolts and


PROCESS OF DOCKING
ELEVATION
WATER LINE
PONTOON DETACHED AND BALANCE OF DOCK PUMPED UP LEAVING PONTOON FLOATING FREE.
PLAN
PONTOON PARTIALLY WITHDRAWN
END VIEWS
WATER LINE
PONTOON IN POSITION READY FOR SELF-DOCKING, AND PONTOON SELF-DOCKED.

pins as the connections are opened. At each self-docking these calculations must be repeated as the interior water levels will vary with the accumulations of growth and sediment on the interior and exterior of the dock. In other methods the submergence of decks of separated parts, acting as water planes, will cause surging that is troublesome and may be dangerous. In the design under discussion all of this has been overcome. A pontoon being disconnected, the balance of the dock is slightly pumped up and the pontoon floats free, after which it is regularly docked on the balance of the dock. There are no preliminary calculations for flotation and no submergence of separated decks to cause surging. The process of self-docking a pontoon is illustrated in the accompanying figures. While simple and safe methods of self-docking a floating dry dock will appeal most strongly to those who have had to do with this operation, the value and importance of the time required will appeal with equal force to every one. It is of the very greatest importance both from a commercial and a military standpoint that self-docking should take as short a period as possible. If self-docking requires a long time it may result in the interruption of business and the loss of work, or it may mean the temporary or permanent loss of a battleship, or the lowering of the efficiency of a fleet from loss of speed due to lack of cleaning foul bottoms. Most methods of self-docking require from two to three months at the least for cleaning and painting alone. This is due to the fact that the entire dock is extensively separated into parts at one time and reconnected for self-docking in an abnormal condition. In the method proposed only a small fraction of the dock is separated from the main part at one time and the self-docking of this small part is a normal operation, the same as the regular docking of a ship. To separate and self-dock a pontoon by the proposed method would require only a few hours; to replace the pontoon would require only a few more hours, so that this method of self-docking is a matter of days where it is ordinarily a matter of months. The continual readiness of a floating dock for use is very desirable. With the proposed type this is secured by having a spare pontoon. When a pontoon is detached for self-docking, the extra pontoon is put in its place and the dock is then ready for its full function. With a spare pontoon the dock need not be out of working order more than six hours at the most. Those who have been directly concerned with floating dry docks fully appreciate that continuous and careful preservation is of the utmost importance if the dock is to be kept up to its original strength and a long life insured, for when deterioration once begins it is difficult to overcome and stop. The proposed design of dock is particularly adapted to continuous and easy preservation. The pontoons may be docked periodically in rotation and when docked are in the best possible position for being conveniently worked on. Their entirely safe position and the safe condition of the balance of the dock does away with any necessity of undue haste. The ease and quickness of self-docking a pontoon also makes it possible to self-dock for inspection alone, an operation which is prohibitive with a dock that requires from one to two months to self-dock. The design of this proposed dock as a weight-carrying structure is perfectly simple and definite and is the equivalent of a plate girder bridge with its floor beams. The longitudinal

stresses are definitely carried by the side walls and the transverse stresses by the pontoons. In designing a floating dry dock it is frequently the case that some longitudinal stiffness is credited to the pontoon portion; as the most of the weight is received by the central bulkhead and as this is a girder in the general proportion of six hundred feet of length to twenty feet of depth, it is evident that without excessive weight in the central bulkhead its resistance to bending is slight, especially in the early stages of deflection. The entire absence of longitudinal stiffness in the original sectional docks that had no rigid connections whatever between the sections has left a prejudice against joints in a side wall. It is, however, perfectly evident that a joint can be designed for a side wall that will be stronger than the body of the side wall itself, and this with no great excess of material. Where a joint in a side wall must be opened every time a self-docking is undertaken, there is naturally a tendency to make the connections as few as possible consistent with safety. In the proposed design the side wall joints are not opened in regular self-docking and from that point of view might be omitted entirely. The joints are to permit the separation and extension of the dock when separation or extension may become desirable, and being for this purpose alone may readily be made stronger than the body of the side walls without in any manner retarding the self-docking process. By making the side wall joints at least as strong as the body of the side wall it makes no difference whether a joint comes at the center of the dock or elsewhere during the docking of a ship. The importance of being able to expand a floating dock in dimensions, and especially in lifting power alone, is best illustrated by reference to the government floating docks at New Orleans and in the Philippines. The New Orleans dock is rated at fifteen thousand tons, and the Philippine dock at sixteen thousand tons capacity. Within six and twelve years of their completion both of these docks have become too small in lifting capacity for the modern ships of the navy. In length, width, and submergence capacity they might still be used, but their lifting power has been greatly exceeded by modern war vessels and there is no way of increasing it. In the proposed type the increase of lifting power by substituting deeper or longer pontoons is as simple and economical a way as could be devised, and the actual substitution would take no longer than a self-docking. The lifting capacity of a floating dry dock can not be increased by placing low bulkheads across the ends and covering the openings in the deck to form a shallow pound to be pumped out, without straining the dock beyond what it was designed for. If the dock is designed originally for such a pound, it would not be an increase of lifting capacity. There are practical objections to such a pound, also, one of which would be the surging of the large unconfined body of water as the pound was coming above the surface. The Havana floating dry dock, later known as the Pensacola dock, was actually designed and constructed for a pound on the deck, and was called a combined floating and graving dry dock. Instead of bulkheads at the ends, which would have to be higher than the blocking to be of any use, it had low caissons that were to be seated as the dock came up. It was found in practice that the rush of water off the deck as the dock came up made it impossible to seat the

caissons in their grooves and they were never used. Expansibility of a floating dock in dimensions is of more importance from a commercial point of view than from a military point. For a full return on the investment a commercial dock must be generally worked to nearly its full capacity. This means that it should not be designed for much beyond the average ship that visits its port. If, however, the dock is so designed that its dimensions can be increased, the gradual increase of the average ship is readily taken care of. It may also be possible that capital is available for a dock of small dimensions, but not for a large one; if the small dock is of an expansible type it may be increased in size with its own earnings. The maximum possible ship that may visit a port can not be taken into account by the ordinary commercial dock unless the ship is a regular patron; two average expansible docks of the same type, however, can be readily coupled up to handle such cases to advantage, while ordinarily the two docks are both in use for the average business. In an expansible dock it is an advantage to have each section fitted with its own pumping machinery. When so fitted the operating power is always correctly proportioned when the dock is either separated or expanded. Furthermore, it makes the power elastic and the chances of complete failure of operation from a break-down are greatly reduced. In this proposed type of self-docking steel floating dry dock, the peculiarities and deficiencies of preceding types have been considered and avoided as much as possible, and the object has been to secure the following results: A dock that can be continuously preserved with the least time, trouble, danger and expense. One that can be readily, quickly and economically expanded through long periods to meet seen and unforseen conditions. One that admits of separation before or after expansion. One that can be quickly and economically built in any location. One that can be towed from one locality to another without extraordinary preparations or facilities.

GERMAN BATTLESHIP "KAISER."

PROFESSIONAL NOTES.

Prepared by LIEUT.-COMMANDER RALPH EARLE, U. S. Navy.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

ARGENTINE REPUBLIC.

VESSELS BUILDING.

Name	Displacement	Speed.	Armament	Builders	Remarks
Battleships					
Rivadavia.....	28,000	22.5	12 12-in., 12 6-in.	Fore River Co.	Launched Aug. 26, 1911.
Moreno.....	28,000	22.5	same	New York Co.	" Sept. 28, 1911.

The Senate has voted by 15 to 14 votes to construct a third *Dreadnought*. This was voted in spite of the opposition of the Ministers of Foreign Affairs and Finance.

The completion of the two *Dreadnoughts* under construction in the United States is awaited with impatience and much interest by the people.

The Minister of Marine has made known the fact that the total naval needs will not be under 145 million francs, an increase of 5 millions over the last years. One hundred and twenty-five millions of this are for the running expenses of the fleet, the rest forms a supplementary and absolutely necessary budget. First there is need to provide for an increase of 2000 officers, seamen, and engineers, which form the crew of the new battleships and of the twelve new destroyers. And this is but half of what is necessary to put the fleet on a war footing.

AUSTRIA.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Viribus Unitis.	20,010	20	12 12-in., 12 5.9-in.	Trieste.	Commissioned
Tegetthoff.....	20,010	20	same	"	Launched Mar. 21, 1912.
Prinz Eugen..	20,010	20	same	"	Launched Nov. 30, 1912.
VII.....	20,010	20	same	Fiume	Laid down 1912

THE "VIRIBUS UNITIS."—This vessel was commissioned September 26, or 29 months from her laying down.

During the week ending August 24 the trials of the *Viribus Unitis*, Austria's first *Dreadnought*, proceeded without interruption. Private reports, however, confirm professional opinion that the slight excess of weight in the armament in no way detracts from the vessel's steaming power. All

the builders' steam trials have been accomplished, and the official runs over the measured mile. Pending this test no statement as to the speed or power developed has been made. On August 14 the battleship was dry docked at Pola. The gun trials have already been carried out. The trials of her triple turrets were a success mechanically, but the loading rate thus far attained is lower than in case of the two-gun turrets.

In appearance the *Viribus Unitis* is decidedly handsome, if this term be applicable to a modern armor-clad. The two views given herewith were taken from a post card.

The length is 488.7 feet, the beam is 88.5 feet, the displacement is 20,500 tons, and speed will be greater than 22 knots. Battery is twelve 12.2-inch 50-caliber guns, twelve 6-inch and eighteen 2.8-inch guns. Armor belt about 11.5 inches in thickness, protective deck 2.4 inches, turrets 12 inches. There are four under-water tubes, one in bow, one in stern, one on each side. The torpedoes are 20.7 feet long, weighing 2794 pounds, and give at 3280 yards a speed of 40 knots.

She exceeded her designed speed by about three-quarters of a knot. She was designed for 21 knots and on trial made 21.8. She floated but 1.6 inches deeper than intended. Some ships steam better in such circumstances. This was very noticeable in the trials of the German *Nassaus*, which are known to draw a good deal more than the designed draft.

The eight hours trial proved satisfactory, all main and secondary machinery functioned without a hitch. The maneuvering trials were also satisfactory.

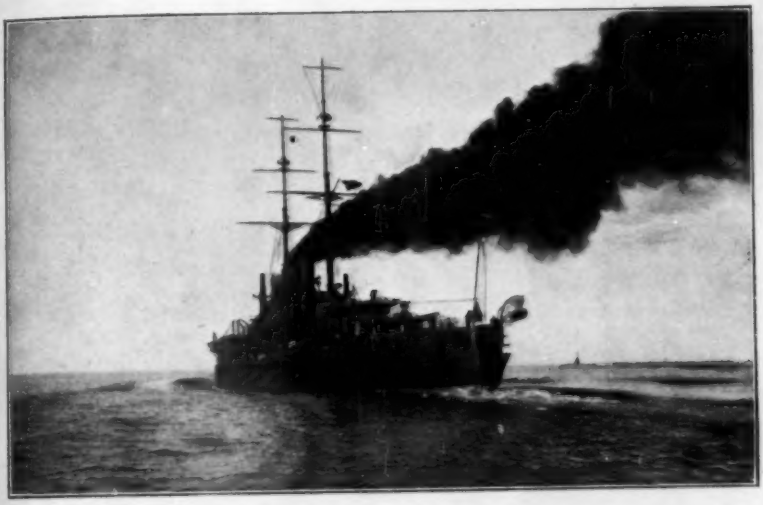
SHIPBUILDING.—The second ship, *Tegetthoff*, is making rapid progress in the fitting-out basin at Trieste. It is understood that all four turrets, with their 12-inch guns, are in position, and work on the superstructures is under way. The third ship (officially designated "Battleship VI") may be launched about the middle of February. A report from Fiume says that the hull of the fourth *Dreadnought* ("Battleship V") is taking shape on the slip, and is due to be launched July 4, 1913.

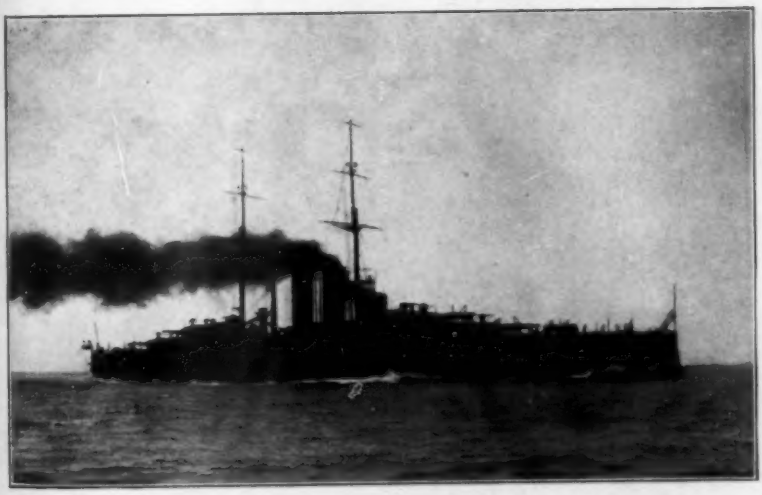
The three small cruisers of the *Admiral Spaun* type, known as "C," "H," and "J," are to receive respectively the names of *Saida*, *Helgoland*, and *Novara*. The following names have been selected for the six 800-ton destroyers shortly to be launched at Fiume: *Tatra*, *Balaton*, *Gsepel*, *Lika*, *Orjen*, and *Triglav*.

The *Saida* was launched on October 28. Her displacement is 3500 tons, her designed speed is 27 knots, and she will carry seven 4-inch guns, two above-water torpedo-tubes.

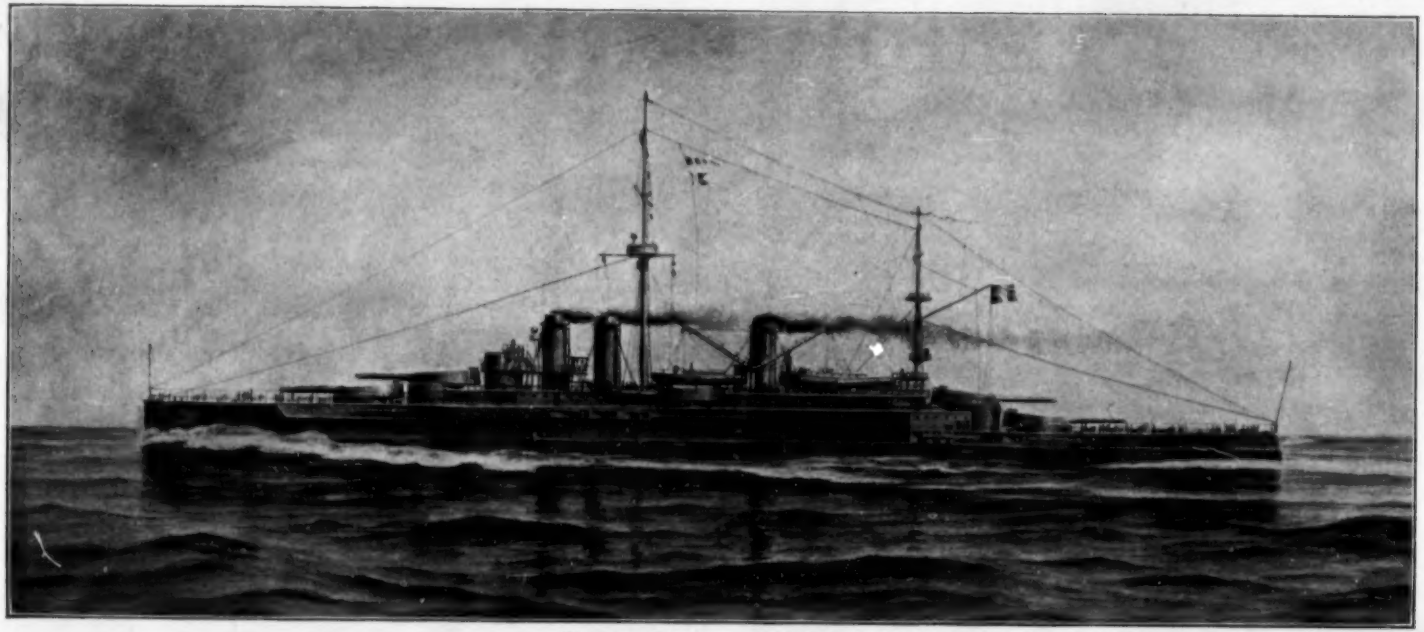
At Pola they have commenced building a turbine mine layer of 1000 tons displacement. The three small mine tenders *Dromedar*, *Salamander* and *Basilisk*, of 174 to 314 tons displacement, are too small for efficient service in heavy seas.

BUDGET.—At the concluding session of the Austrian Delegation held at Vienna on October 15, Admiral Count Montecuccoli, the Minister of Marine, promised to lay before the delegates, with as little delay as possible, the new shipbuilding program which he had been authorized to draw up to replace the obsolete Monarch division of battleships. He stated that three battleships of the largest type would be asked for, to be armed with the 45-caliber 13.4-inch B. L., which was recently tested with complete success at the Skoda-Werke. It is understood that each ship will carry a main battery of ten of these guns, disposed in double turrets on the center line, but an alternative plan which has been published in Austria provides for two triple and two double turrets, the disposition resembling that of the United States battleship *Nevada*, the weapons in the triple turrets being locked together for training and firing simultaneously. Protection, both externally and internally, will be given in conformity with the most modern principles.





AUSTRIAN BATTLESHIP "VIRIBUS UNITIS."



FRENCH BATTLESHIP "PARIS."

The first hydroaeroplane received in the Austrian Navy was a biplane of Lohmeier-Daimler type and was tried during August at Pola.

MANEUVERS.—The partial mobilization at Pola will, it is reported be followed by the cruise of an armored division in the Adriatic. All the ships to take part have had their ammunition and provision supplies brought up to the maximum. A torpedo flotilla will accompany the division.

BRAZIL.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleship					
Rio de Janiero.	27,500	22	14 12-in.. 20 6-in.	Elswick	Started Sept., 1911

RIO DE JANEIRO.—This vessel has very light armor for a battleship, 9 inches being maximum thickness. It is 632 feet long, 90 feet beam, and has a designed horsepower of 45,000. Many changes in design have been made, but the vessel should be launched in December.

The Brazilian coast defence battleships *Deodoro* and *Floriano*, designed and built at La Seyne in 1898, are undergoing considerable overhaul at Rio de Janeiro. In place of the original Lagrafet d'Allest boilers, those of the Babcock & Wilcox type are being supplied, and in many other ways the machinery and armament is undergoing extensive overhaul.

The names of the three Brazilian monitors now under construction in this country are the *Javary*, *Madeira* and *Solimoes*. They are of about 1200 tons displacement, and are 265 feet long, 50 feet wide, and 4 feet 6 inches draft. The speed is 11.5 knots.—*The Engineer.*

CHILE.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Almirante Cochrane	27,500	23	10 14-in., 16 6-in.	Elswick	Laid down Nov. 1911.
Almirante Latorre	27,500	23	same	Vickers	" " Dec. 1911.

NAMES OF BATTLESHIPS.—It will be noted that these are changed since last issue. The names given in that issue were those by which they were then known, later they were called *Valparaiso* and *Iquique* tentatively, but on objections by the Chilean press, the names were fixed by a presidential decree as *Almirante Cochrane* and *Almirante Latorre*.

Turbines.—The contract for turbines for these vessels has been given to John Brown & Co., of Clydebank. The shaft horse-power is to be 37,000.

Dimensions.—They displace 28,000 tons, are 661 feet long, 92 feet beam, 28½ feet draft, with a speed of 23½ knots. They are to cost $11,316,839.60. The *Latorre* is to be completed August, 1914, and the *Cochrane* March, 1915. Armament is ten 14-inch, sixteen 6-inch; side armor 9-inch, barbettes 10-inch, and casemates 3-inch.

DESTROYERS.—The first of the six being built in England has been launched. This vessel, the *Tome*, has a displacement of 1850 tons, is driven by Parsons' turbines, and is to make 31 knots. Length is 320 feet, beam 32½ feet, battery of six 4-inch guns, and three 18-inch torpedo-tubes.

FRANCE.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Courbet	23,500	20	12 12-in., 22 5.5-in.	Lorient	Launched Sept. 23, 1911
Jean Bart	23,500	20	same	Brest	" Sept. 22, 1911
France	23,500	20	same	St. Nazaire	Launched Nov. 7, 1912
Paris	23,500	20	same	La Seyne	Launched Sept. 28, 1912
Bretagne	25,000	20	10 13.5-in., 24 5.5-in.	Brest	Laid down May, 1912
Provence	25,000	20	same	Lorient	" " May, 1912
Lorraine	25,000	20	same	Bordeaux	" " Aug, 1912

THE "PARIS."—The launching of the battleship *Paris* at Toulon with unusual ceremony in the presence of the members of the Municipal Council of Paris, had the desired effect of stimulating the popular imagination and creating public interest in the navy. This interest has been growing enormously of late, owing to the confidence inspired by the administration of M. Delcassé, who has worked wonders in the way of creating a navy that can be relied upon in the place of the miscellaneous assortment of ships that had been built by his predecessors.

Constructed by the Chantiers de la Seyne, the *Paris* has only been nine months on the stocks, and this fully justifies the action of the Minister of Marine in having some of the battleships built in private yards, which have beaten the record of the arsenals in the rapidity with which the work has been carried out.

The *Paris* is the third *Dreadnought* of the *Jean Bart* class, and has the same dimensions; that is to say, a length between perpendiculars of 525 feet, beam 86 feet, and draft 28 feet. Its displacement is 23,467 tons. The armament will consist of twelve guns of 12 inches, twenty-two of 5.5 inches, and four 3 pounders.

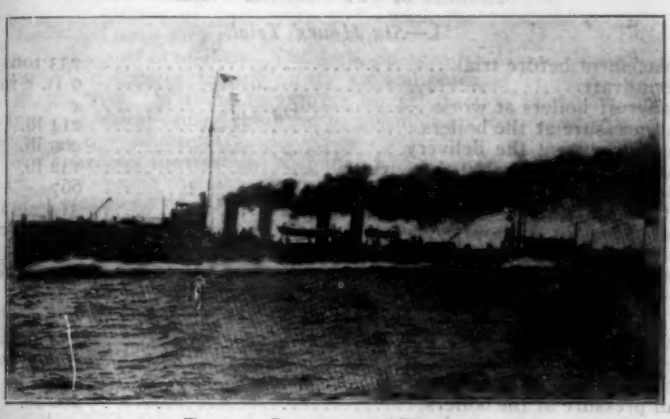
The broadside of this vessel is eight 12.50-inch guns. The secondary battery is composed of twenty-two 5.5-inch 50-caliber guns. There are four 18-inch submerged tubes, all on broadside. The propelling machinery consists of Parsons' turbines driving four screws. The horse-power is 28,605 I. H. P. The boilers are of the Delaunay Belleville type. The armor protection consists of a complete Krupp belt 16 feet 1 inch wide, extending 7 feet 9 inches above water-line, 10.6 inches thick amidships and 7.1 inches at the ends. Turrets are protected by 11.8-inch armor, the barbettes being 11 inches. The battery and main deck amidships is protected by 7.1 inches, the conning-tower by 11.8 inches, the deck on the flat below the armor belt by 2.7 inches, the upper deck by 1.9 inches, and the bases of the funnels by 7.1-inch armor.

Moreover, the *Paris* and *France* have benefited by a series of improvements, which will add to their general efficiency. Their armor is made of special steel, manufactured at St. Chamond on totally new principles, and adopted after a series of comparative tests (at Gâvres) which demonstrated its enormous superiority over Krupp plates, especially against capped shells. This new steel, which contains a high proportion of chrome and nickle, will also compose the defence of the next 27,000-ton quadruple turret super-*Dreadnoughts*.

Some other details of this vessel are worthy of note. There is a specially designed magazine flood system which is centralized, and duplicated, so as to work in action when one lead might be shot away. One series is in the conning-tower, the other on the bridge.

FRENCH DESTROYERS "DAGUE" AND "CIMETERRE."—The French destroyer *Dague* has completed her official trials with good results, and the French Navy is somewhat proud of her success, as she has been completely built according to French drawings. The hull has been designed and built by the Gironde firm; the turbines have been supplied by the Breguet firm according to their own patents; it and the Rateau-Chantiers de Bretagne are the only two builders of French marine turbines under French patents. The boilers are of the "du Temple" type.

The principal dimensions are: Length over all, 255 feet 11 inches; length between perpendiculars, 251 feet 1 inch; extreme breadth, 26 feet 1 inch; breadth at low-water level, 25 feet 10 inches; depth, 16 feet 9 inches; draft astern, 9 feet 8 inches; trial displacement, 730 tons; displacement fully loaded, 770 tons.



FRENCH DESTROYER "DAGUE."

The hull is built of high tensile steel, with longitudinal and cross strengthening, and is divided into 10 water-tight compartments. The vessel has a high freeboard, and forward there is a lofty forecastle, which gives her better seagoing qualities than those of the previous types. The excellence of her lines is shown by the fact that under full power she raises but a small wave, and it is not followed by what is called a "satellite wave." Indeed, the following wave of the *Dague* is of ordinary dimensions, and does not interfere with the speed more than with other similar boats.

Steam is supplied to the main and auxiliary engines by four "du Temple" water-tube boilers operated by liquid fuel—mazout. These boilers have a heating surface of 1920 square meters (=20,667 square feet), the combustion chamber being 14 cubic meters (=494 cubic feet) per boiler. There are 11 Thornycroft burners to each boiler; they deliver the fuel under a pressure of 143 pounds per square inch. Thornycroft fuel heaters are also used. These boilers are designed to work at a pressure of 215 pounds; they are so arranged as to burn 12½ tons of liquid fuel in six hours under full power. The air pressure was to be 160 mm. of water, according to the first drawings.

The main engines consist of two independent sets of Breguet turbines, each of them driving a shaft. In each casing there are an ahead and an

astern turbine. They have been designed to develop an average shaft horsepower of 1500 at a speed of 630 revolutions per minute, the contract speed being 31 knots. The Breguet turbines are of the impulse type, and are mounted on drums. The thrust of the steam acting on the blades is counterbalanced by the propeller thrust. A small thrust bearing takes any difference. Each turbine drives a single three-bladed propeller of 7 feet 1 inch diameter and 6 feet 7 inches pitch. After experiments, this propeller has given far better results than the usual four-bladed one, which will not again be used by the builders on boats of this type. Each turbine has its own independent condenser, having a cooling surface of 5813 square feet (540 square meters).

The fuel is stored in the double bottom and longitudinal tanks on both sides of the boiler rooms. The total capacity is 160 cubic meters (=5650 cubic feet). The theoretical radius of action is 2060 miles.

The armament consists of two quick-firing guns of 100 mm. bore, fore and aft, and four 65-mm. guns, together with four 18-inch torpedo-tubes.

RESULTS OF THE OFFICIAL TRIALS.

I.—*Six Hours' Trial.*

Displacement before trial	733 tons
Astern draft	9 ft. 8 in.
Number of boilers at work	4
Mean pressure at the boilers	214 lb.
Mean pressure at the delivery	200 lb.
Mean pressure of fuel at the burners	142 lb.
Mean number of revolutions	667
Contract speed	31 knots
Mean speed for six hours	33.118 knots
Consumption as per contract	12½ tons
Consumption on trials	11.150 tons

II—*Eight Hours' Consumption Trial at 14 Knots.*

Displacement before trial	734 tons
Astern draft	9 ft. 8 in.
Number of boilers at work	2
Mean pressure at the boilers	200 lb.
Mean pressure at steam chest	49 lb.
Mean pressure of fuel at the burners	58 lb.
Mean number of revolutions	244.16
Speed as per contract	14 knots
Speed on trial	14.3 knots
Consumption per hour	1.031 tons

—*The Engineer.*

The *Bouclier*, of 650 tons displacement, as noted on p. 309 of No. 141 of the PROCEEDINGS, equipped with Normand boilers, attained 35.334 knots on her trial. Contract speed was same as that of the *Dague*. The *Bouclier* is still the speediest destroyer in the French Navy.

SUBMARINES IN THE MEDITERRANEAN MANEUVERS.—The *Moniteur de la Flotte* has the following to say of the work of the submarines in the French Mediterranean maneuvers:

Attack of the 2d squadron at the Ajaccio anchorage (July 19). At dawn, screened by the blockading fleet, the submarines ran submerged in column and passed under the two lines of destroyers on guard, and in succession came to surface in the roadstead . . . . but the enemy was not there. The 2d squadron had forced the blockade in the night; and returned to port about 7 a. m. The submarines again attacked at 11 a. m., and successfully.

Attack of the 2d squadron on route to the eastward from Bonifacio (July 22). The submarines apprised of the departure of the battleships from Bastia and of its general course to the southward, cruised to intercept them 30 miles out on the high sea. Wind was from W. S. W. blowing in heavy squalls, the sea very heavy. *L'Épée* sighted the enemy to northward and the five submarines dived. They did this well in spite of the heavy weather, and succeeded absolutely without being sighted. We note that the destroyers, on account of the heavy sea, could not participate in the maneuvers. After the attack the submarines reached the rendezvous at Lavezzi, and reached Ajaccio the next day.

Attack of the fleet on the high sea to N. E. of Balearic Islands (July 27). The admiral having designated a rendezvous, the flotilla left Ajaccio at 6 p. m. on 26th. The fleet is late. A reconnaisance by the *Épée* and then a successful attack despite the five destroyer flotillas.

Attack of the 1st squadron at anchor in Gulf of Juan (July 29). The 1st squadron is blockaded by the 2d and by the light squadron to which belong the submarines. These took a position in the afternoon near the cruisers 12 miles to sea. They leave, submerging successively, clear successfully the guards of destroyers and attack the battleships. They are not discovered until they rise to the surface.

The flotilla anchored then. The 30th, on account of a violent gale, they took refuge at Cannes, leaving on the 1st and reaching Toulon at the same time as the fleet. Wishing to express his satisfaction at the work of the flotilla, the admiral caused the band to assemble on the *Voltaire's* poop and to play the Marseillaise.

The submarines thus proved that they had a remarkable endurance, they have cruised during the maneuvers more than 800 miles on the surface and 100 miles submerged. Obliged at anchorages to recharge by their own means their accumulators, forced to make numerous trips for matériel, their crew hardly knew the feeling of sleep, and their behavior throughout could not have been better.

There were—it could not be otherwise—some accidents; they were not serious enough to have prevented the submarines from fulfilling their mission in war. The *Cugnot*, with only one motor, took part in the attack off Bonifacio. The *Gay Lusac* had one of its oil engines disabled, but kept on. The *Monge* went ashore at the jetty of St. Tropez and broke her starboard screw, she kept with the flotilla, using one motor both on the surface and submerged.

The tactical results are excellent and are the best proof yet that the building of these vessels of large size and great speed which will form a true submarine fleet is justified.

SUBMARINES IN THE NORTH SEA.—In the Channel the under-water flotillas of Admiral de Marolles successfully attacked the Troisième Escadre off Beachy Head and in mid-Channel, despite the stormy weather, which proved extremely trying to contretorpilleurs, and kept small torpedo-boats in harbor.

Thus these flotillas are not limited to coast and harbor, but it appears they can take the high sea. Admiral Marolles sent this signal concerning the Calais submarines, "very fine results for the submersibles which, in spite of the gale, reached the squadron." On August 4 the flotilla sailed, the anchorage of the battle fleet being known. They reached and attacked the fleet successfully. These submarines had been underway in very heavy weather for 30 hours. Thus the French 400-ton submersibles, blind and slow, are capable of inflicting heavy damage on a division separated from the main fleet or in retreat.

THE "JOULE."—The French submarine *Joule*, 398 tons, with explosion motor, recently cruised a distance of 800 miles without any disturbance of her machinery.—*Marine Rundschau.*

FIRE IN A SUBMARINE.—Fire broke out November 3 on board a French submarine in dock at Cherbourg, as the result of the carelessness of a foreman. All the crew at once left the vessel, and the hatches were closed down. The fire could not spread as the submarine was isolated in a dock, and soon burned itself out for lack of air.—*Naval and Military Record.*

TORPEDOES.—The Whitehead torpedo firm are establishing a branch factory in France on the Gulf of the Var.

POWDERS.—Only those with diphenylamine incorporated therein are permitted to be kept on board ship.

During the firing on the *Pothnau*, in the presence of the Ministry, Commander Schwerer was able to produce at will the ignition of the power gas, and thus reproduce the conditions of the accident on the *Jules-Michelet*. It thus appears that the cause is known. A new system of gas ejection has been developed and gives every indication of being efficient.

PERSONNEL NOTE.—The shortage of men in the French Navy is such that two-fifths of the total required are lacking on battleships of the third squadron, while Admiral Lapeyrere's force is about 1500 men short. The shortage is attributed to the disasters caused by powder explosions, the steps taken to reorganize the men, and the increase of examinations for all ranks. —*Shipping*, Illustrated.

NAVAL POLICY.—The sending of the North Sea squadron of the French Navy to the Mediterranean has left the defence of the coast of the Channel and the Bay of Biscay to destroyers and submarines. Cherbourg has been selected by the French Government as the base for a fleet of twenty-four of the swift craft and a large number of submarines. The destroyers, which will be known as the flotilla squadron of the Channel, will be charged with the defence of the coast between Cherbourg and Havre, and protect such ports of commerce as Calais and Boulogne, Granville, St. Malo, but especially Havre and the mouth of the Seine. With the exception of two submarines, which will be sent to Toulon, all the submarines of the French Navy will remain at Cherbourg to join the destroyers in either defensive or offensive action in case of war.—*Army and Navy Journal.*

NOVEMBER MANEUVERS.—The grave reproach which naval students have long addressed to the French fleet that it lacked tactical practice as well as chiefs experienced in the handling of squadrons at sea is to-day no longer justified in the presence of the strenuous and realistic war preparation that has prevailed in the Mediterranean ever since the Première and Deuxième Escadres have been united under the strong man of action, which is Admiral de Lapeyrère. As a matter of fact, the armée navale will have seen more training at sea during the present year than it did in several previous years. It has carried out interesting combined maneuvers in the spring and summer, and now, on the arrival of the Troisième Escadre in the Middle Sea, it is to study for the third time the problem of the utilization of gun power, maneuvering ability and speed, in a series of strategic and tactical exercises, to commence in the first days of November. There will be two forces. The Red, under Admiral de Lapeyrère, comprising six *Dantons*, three *Gambettas*, eighteen destroyers, and five submersibles, and having Toulon as its base, will have to seek, find, and destroy separately the two fleets of Blue, viz., the six *Patrie-Suffren*, six destroyers, and four submersibles of Admiral Bellue, based on Bizerta, and the six *Bouvets*, three *Quinets*, six destroyers, and two submersibles of Admiral de Marolles, which will start from Algiers to try and effect a junction with the Bellue squadron. The sea speed to be kept is 18 knots for the armored cruisers, 16 knots for the *Dantons*, 15 knots for the *Patries*, 13 knots for the *Bouvets*, and 20 knots for the destroyers, which represents approxi-

mately the rate of going these divers units can maintain under easy conditions, and will permit the efficiency of the machinery to be thoroughly tested. The "hostilities" are only to commence when Red has reached the southern coast of Sardinia, and a blockade of the Deuxième Escadre, in Bizerta, is not improbable. In any case, the operations off the Tunisian shore will provide ample scope for the action of torpedo-craft.—*Naval and Military Record.*

GERMANY.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks.
Battleships					
Kaiser.....	24,500	21	10 12-in., 14 5.9-in.	Kiel (Kaiserliche)	Commissioned
Friedrich der Grosse	24,500	21	same	Hamburg (Vulkan)	"
Kaiserin.....	24,500	21	same	Kiel (Howaldt)	Launched-Nov. 11, 1911
Prince Regent Leopold	24,500	21	same	Germania Works	" Feb. 21, 1912
König Albert..	24,500	21	same	Danzig (Schichau)	" April 27, 1912
Ersatz K. F. Wilhelm	27,000	21	10 14-in. (probably)	Hamburg	Laid down Nov., 1911
Ersatz Weissenburg	27,000	21	same	Bremen	" " Nov., 1911
Ersatz "S" ...	27,000	21	same	Wilhelmshaven	" " July, 1911
Ersatz Brandenburg	27,000	21	No details	Germania	Projected
Cruisers of the Line					
Seydlitz	22,600	27	8 12.2-in., 12 3.4-in.	Hamburg	Launched Mar. 30, 1912
Ersatz Kaiserin Augusta	28,000	27	10 12.2-in., 12 6-in.	Dantzig	Building
"K" 1912.....	28,000	27	same	Hamburg	Laid down June, 1911
Protected Cruisers					
Breslau.....	5,000	29	12 4.1-in.	Stettin	Commissioned
Magdeburg....	5,000	29	same	Bremen	"
Stralsund	5,000	29	same	"	Launched Nov. 4, 1911
Strassburg	5,000	29	....	Wilhelmshaven	Undergoing trials
Ersatz Seeadl'r	5,000	28	....	Germania	Building.
" Geier ..	5,000	28	....	Howaldt	"
" Irene	5,000	28	....	...	...
" P. Wilhelm	5,000	28	....	...	...

THE "KAISER."—On August 28 this vessel became the flagship of the commander-in-chief of the North Sea fleet.

In her official trial trip on September 12 she made an average speed under forced draft of 23 3-5 knots an hour. The course was over a measured mile.

Her length is 564 feet, beam 95 feet, draft 27 feet. This is the first of the German battleships to be equipped with turbines. These are of the Parsons' type and the vessel has Schultz boilers. Her bunker capacity is 3543 tons.

THE "FRIEDRICH DER GROSSE."—The new battleship *Friedrich der Grosse*, which has been chosen as the flagship of the high sea fleet, anchored recently off Cuxhaven, her appearance attracting a crowd of spectators. In spite of the massive armor which is known to protect this vessel, she looks surprisingly light afloat and quite graceful. The 5.9-inch quick-firing casemates are well above the water, but from their position it would appear that the accommodation for the gunners is very cramped. The conning-tower is a peculiar-looking structure of two stories, the lower one being larger than the average charthouse. No doubt the upper story, which is

small and placed well abaft, constitutes the central fire-control station. At present the masts are without fire controls, but these are to be fitted at once. The amidship turrets en échelon have notably clear training arcs, the absence of intervening superstructure giving them a clear field. The smaller guns are mounted at the same level as the stern 12-inch turret, and should be workable in a heavy sea. Between the fore and after turrets the upper armor strake runs flush with the main deck, and is unpierced by a single port or break of any kind. As far as external observation goes, the greater portion of the hull of this vessel should be invulnerable to the attack of all save the heaviest projectiles. Top-hammer has been cut down to a minimum, leaving but little surface exposed to light high explosive shells. The funnel bases are protected by armored screens of characteristic design, the object of which is to cause the bursting of any projectile before it can penetrate the funnel itself. On the whole, the main features of this ship—the second of the *Kaiser* class of five units—while they have no great claim to originality, give evidence of the most careful consideration on the part of the designers.

The first steam trials of the *Friedrich der Grosse* were carried out in very boisterous weather, as were also the preliminary gun trials, and it is known that she proved herself a steady ship. It may not be known commonly that all German armored ships built since the opening of the *Dreadnought* era are equipped with Frahm anti-rolling tanks. The first ship to be so fitted was the armored cruiser *Scharnhorst*, built at the yard of Blohm & Voss, of which firm the inventor, Dr. Frahm, is a member. Notwithstanding that the tanks then installed were of somewhat primitive design, they demonstrated their efficacy to the complete satisfaction of the authorities, and possibly they have something to do with the accurate shooting for which this vessel is noted. Tanks were next furnished for the cruiser *Blüecher*—another famous gunnery ship—and the group of *Nassaus*, and, indeed, for all subsequent ships. It transpires that the cruise of the *Elsass* and *Blüecher* to the Faroes last spring was as much for the purpose of testing the respective steadiness of the two vessels as gun platforms, the first named having no tanks, as for the prosecution of other gunnery experiments. If, as is claimed in Germany, warships fitted with this invention are much less inclined to roll in heavy weather than warships unprovided with them, it cannot be gainsaid that the tanks confer a valuable tactical advantage, or that a fleet of ships so equipped would be in a position to meet on advantageous terms a rival force the units of which had no similar equipment. It is plain, therefore, that the question is of considerable importance.—*Naval and Military Record.*

SPEEDS OF GERMAN BATTLESHIPS.—The *Kieler Neueste Nachrichten* states that the *Kaiser* has made 23.6 knots as maximum mean speed for her trials over the measured mile. This puts her at the head of the turbine-driven battleships for speed. The speeds assigned the vessels of the *Helgoland* class are authoritatively quoted as:

	Knots.
Oldenburg	21.5
Ostfriesland	21.239
Thüringen	21.075
Helgoland	20.81

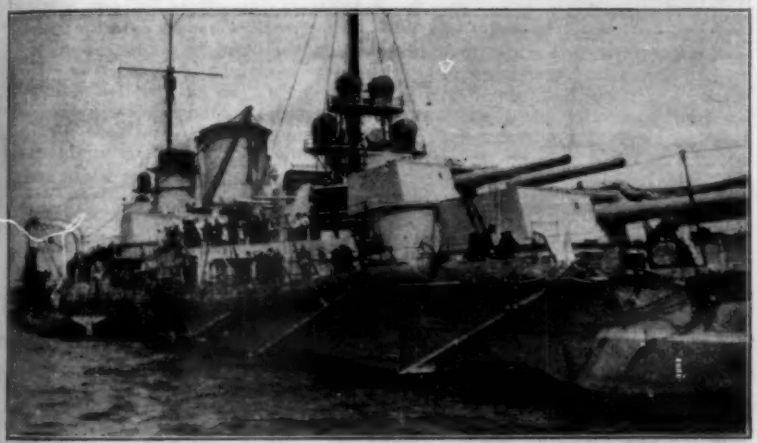
The *Kaiser* is the first turbine driven large vessel built and engined by the Imperial dockyard at Kiel. The Imperial dockyard at Wilhelmshaven follows when they finish the new cruiser of the line "S." The next turbine battleship to have her trials will be the *Friedrich der Grosse*, which has A. E. G. turbines. The *Kaiser* has Parson's turbines.—*Revue Internationale.*

The German review, *Schiffbau*, publishes the high speed made by the *Kaiser* and attaches thereto an interesting comparison of the speeds made by the fastest battleships of the five most important maritime powers:

	Knots.
Germany: *Kaiser*	23.6
England: *Neptune*	21.8
United States: *Utah*	21.6
France: *Voltaire*	20.7
Japan: *Kawachi*	20.5

This table shows that the *Kaiser* is ahead of her nearest competitor by 1.8 knots. We hope that her sister ships will even succeed in beating their contract speeds in like manner so that the squadron will be homogeneous. The speed of a squadron is always that of its slowest unit, therefore if one of the other vessels, *Kaiserin, Friedrich der Grosse*, and *Prince Regent* should only reach a speed considerably less, which is quite possible, due to the fact that all are fitted with different types of turbines, the excellent result reached by the Imperial dockyard at Kiel will lose its importance for the German Navy.—*Revue Internationale.*

The *Florida's* speed is given as 22.54 knots, while the English *Vanguard* is credited with 22.5 knots, which facts modify the above table considerably.



TORPEDO-NET STOWAGE ON THE "MOLTKE."

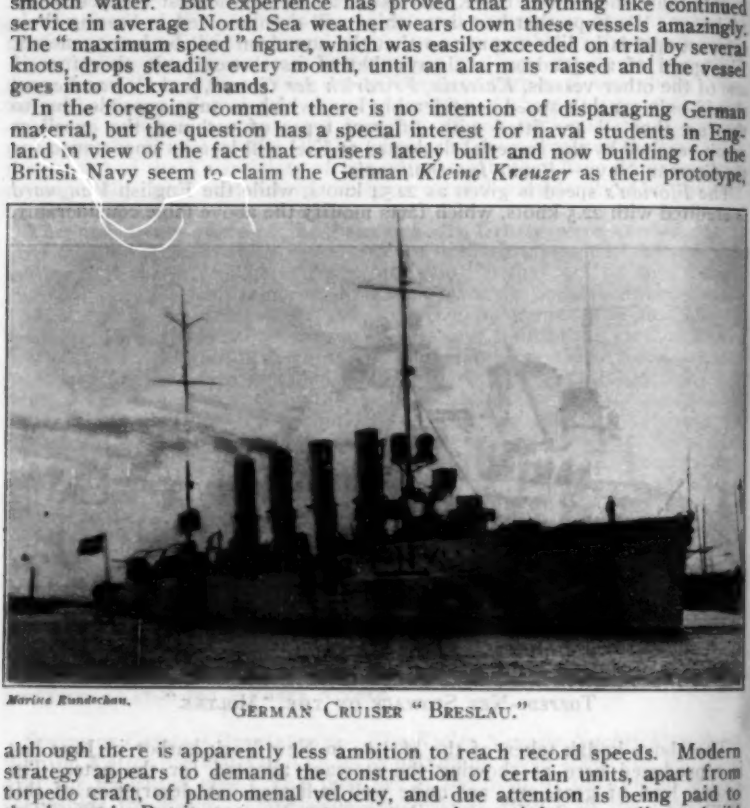
The above kodak taken of the *Moltke* in New York harbor in June last is reproduced here as showing the stowage adopted for the nets. The booms, lead of gear, etc., are quite well indicated. A description of this Bullivant net may be found in PROCEEDINGS No. 142, on page 786. The best time of "out nets" made is three minutes.

The lowness of her gun positions is also well shown, and this has been the cause of much unfavorable comment. These after guns are swept by seas in any moderate weather.

THE "STRASSBURG."—The new cruiser *Strassburg* has arrived at Kiel after doing her trials near Danzig. It is reported that these were run partly in very heavy weather, and that the vessel rolled to an alarming degree. In fact, the trials had to be interrupted, and the cruiser has gone to Kiel to have bilge-keels fitted. The *Magdeburg* and *Breslau*, of the same class, are believed to have had fine weather during their trials, so that their behavior in rough weather has still to be ascertained, but as the four ships of this class are identical it is probable that all are indifferent sea-boats. The transfer of major naval operations from the Baltic to the North Sea

is likely to have an important effect on the design of small cruisers. There is no reason to believe that any of these vessels of recent date fall short of the high German standard of robust construction and seaworthiness but it is a fact that the original design, which has been adhered to essentially in spite of increasing displacement, took more count of Baltic than of North Sea conditions. Lines almost destroyer-like were combined with structural lightness and great engine-power, the result being miraculous speed in smooth water. But experience has proved that anything like continued service in average North Sea weather wears down these vessels amazingly. The "maximum speed" figure, which was easily exceeded on trial by several knots, drops steadily every month, until an alarm is raised and the vessel goes into dockyard hands.

In the foregoing comment there is no intention of disparaging German material, but the question has a special interest for naval students in England in view of the fact that cruisers lately built and now building for the British Navy seem to claim the German *Kleine Kreuzer* as their prototype,



Marine Rundschau.

GERMAN CRUISER "BRESLAU."

although there is apparently less ambition to reach record speeds. Modern strategy appears to demand the construction of certain units, apart from torpedo craft, of phenomenal velocity, and due attention is being paid to the demand. But it seems an extravagant and unsatisfactory policy to build ships which lose their raison d'être a very few years after entering the service.—*Naval and Military Record*.

THE "BRESLAU" CLASS OF CRUISERS.—This class of scout cruisers has shown great speed and is an advance over previous ones mainly in coal-carrying capacity which is 450 to 1200 tons. Turbine drive is used in all, though these are of different makes, those of the *Breslau* being A. E. G., those of the *Magdeburg* being Bergmann. Length is 446 feet, beam 45 feet, mean draft 16.7 feet, with displacement about 4700 tons. Armament is twelve 4.2-inch rapid-fire guns with two submerged tubes. The horse-power is 2400 I. H. P. There are 16 water-tube boilers.

On trials the *Breslau* made 30.4 knots, and the *Magdeburg* 27.5 knots, the rated speed of the class being 26.75 knots.

These cruisers have a different appearance from most German vessels, particularly in the lines of the bow, there being no ram, and the shape of the funnels. The height of the two forward guns indicates they can be used against destroyers in any sea.

GERMAN DESTROYERS.—The newest German destroyers are to carry only two 24-pounder guns instead of the 4.1-inch weapons with which they are credited in certain reference works. It is, of course, well known that the destroyer, as such, does not figure in the German Navy, these vessels being designated by the name of "large torpedo-boats." In that term we get the key to the development of these craft in Germany, whose torpedo-craft have always been notable for their comparatively weak gun armament. It will be seen that on an average English destroyers are more than twice as strong in gunfire as their German contemporaries. Indeed, the newest German vessels will have a gunfire greater by only six pounds than that of the English old 27-knotters. On the other hand, recent German vessels have been considerably faster—a fact which may reasonably be held to make the superior gunfire of English destroyers of somewhat problematical value. The essentially torpedo-boat character of the German vessels is seen by their high speed and greater torpedo armament when compared with our craft. This can be shown most strikingly by a comparison between the fully commissioned vessels of the two navies, there being 68 English and 66 of Germany's. English 68 destroyers all carry two tubes, giving a total of 136. Of the German 66, twenty-two have four tubes and forty-four have three, giving a total for the whole of 220.—*Naval and Military Record.*

SHIPBUILDING.—The delays in the completion of the German ships of the 1912 program caused by the five months strike in the shipyards of Schichau at Dantzig have been the subject of much confidential inquiry between the Minister of Marine and the directors of that establishment.—*Moniteur de la Flotte.*

TARGET PRACTICE.—According to the Berlin correspondent of *The Navy*, the organ of the Navy League, the German Navy intends in future to adopt long-range firing on American lines. At present the Germans do their battle practice at seven thousand yards only, while other nations fire at eleven thousand or so.

It now occurs to the Germans that their theory of sailing within six thousand or seven thousand yards and then bringing into action every gun with a certainty of hitting may be rudely upset by an enemy that starts getting in bad hits at eleven thousand yards.—*The Engineer.*

It is reported on good authority that the battle practice of the first squadron next year will be conducted on principles entirely new to the German Navy. At least one target-ship, and probably two, will be prepared for this occasion. The ships taking part will fire only half their quota of ammunition at individual practice, reserving the remaining half for squadron firing at the target-ships. This squadron practice will be of the order known in the French Navy as salvos alternées et cadencées, which seems to be becoming general among the leading navies of the world, and was tried with conspicuous success by the German cruiser-squadron in the Far East. Extraordinary interest will attach to this practice, in view of the fact that all the first squadron's ships are *Dreadnoughts.* Including the flagship *Friedrich der Grosse*, the squadron has an aggregate broadside of thirty-two 11-inch and forty-two 12-inch guns. To reap the full benefit of the method of fire delivery to be tried next year it is essential that there should be perfect communication between the participating ships, and this in turn involves the difficult problem of the

rapid and accurate transmission of signals in action. It is too much to hope that some account of the firing will be made public, such as was given out after the *Hero* and *San Marcos* bombardments, although a great many people would be glad to learn, inter alia, how long the ill-fated hulks serving as the targets were able to withstand the concentrated fire of 74 big guns!—*The Naval and Military Record.*

THE GERMAN MANEUVERS.—The high sea fleet of which the first squadron counts eight *Dreadnoughts* with three battle-cruisers, was reinforced by the 3d squadron composed of the *Wittelsbach, Schwaben, Mecklenburg, Zaehringen, Wettin* and *Elsass* manned by reserves for the most part. This squadron was given a "shake down" cruise before joining the fleet. With it were 66 destroyers, 12 submarines, 22 mine layers, and 6 auxiliaries. In the fleet were counted 39 battleships and 11 protected cruisers.

This armada is described in the press as the exact fleet with which Germany would take to sea if war should begin at this hour. The maneuvers, to be carried on in the presence of the Kaiser, who will be on board the flagship *Deutschland,* will be based on the theory that a superior force—meaning, of course, the British fleet—has blockaded the North Sea, and, having blocked up the German fleet within the blockade area, is seeking to find it and compel it to fight a decisive engagement.

It becomes increasingly plain from day to day that all the energies of the German Navy Department, like those of the British Admiralty, are directed exclusively toward the possibility of an Anglo-German Armageddon in the North Sea. It was announced, for instance, by the German Navy Department this week that the island of Borkum, which has hitherto possessed only second-rate coast defences, is about to be converted into a first-class fortified position like Helgoland, which has been called the German Gibraltar.

Borkum is one of the islands covering the entrance to the Channel which leads to Emden, and its new fortifications are with a view to preventing a blockade of the mouth of the Ems.

The plan of this year's exercises reflects the probable conditions of a North Sea campaign, in which the German fleet, outnumbered in ships, would have to make full use of its island and mainland bases to frustrate a blockading force and gain the open sea to fight or fly as circumstances dictated. Helgoland is expected to serve as the center of the maneuver zone. The garrison of this island was heavily reinforced.

It is perhaps not without significance that these naval maneuvers were accompanied by the principal officers of the army. The chief of the general staff of the German Army, together with Field-Marshal von der Goltz, General von Heeringen, the Prussian Minister for War, the inspector of field artillery, the chief of the engineer and pioneer corps, and the commanders of three army corps watched from the principal ships the special maneuvers.—*Naval and Military Record.*

The maneuvers took place entirely between Wilhelmshaven, Cuxhaven and Helgoland in the North Sea. They were divided into two parts, the first from 2d to 15th of September consisting of battle practice and maneuvers, the second from 16th to 19th in which the Kaiser assisted. These began by grand review held on the 15th, the Kaiser being on board the *Deutschland.*

As a spectacle, the grand naval review off Helgoland on the 15th inst. was marred by the vile weather, but as an exhibition of German power in the North Sea its impressiveness was perhaps enhanced by the lowering skies and troubled waters. Forty-one battleships and cruisers steamed past the flagship *Deutschland.* Something like seventy smaller craft could be counted. At the appropriate moment when the guns of the fleet begun to crash out the "Kaiser salute," the Zeppelin airship *Hansa* made its appearance, hovering above the flagship and executing maneuvers in the teeth of

an exceedingly strong wind, and altogether demonstrating her wonderful handiness to the most hardened sceptics. It is only fair to state that the cruise of the *Hansa* from Hamburg to Helgoland, a distance of nearly 120 miles, was made against a head wind which averaged a velocity of 50 feet per second, notwithstanding which she flew with marked steadiness, and appeared to be under comolete control.

One remarkable feature of the review was the (to foreign eyes) unnecessary hardship imposed upon the seamen of the destroyers. As these boats steamed at high speed past the Imperial flagship their crews lined the decks, in spite of the heavy seas and sheets of spray which almost hid them from sight. The men must have been drenched through and through, and their position was palpably dangerous, but it was impossible not to admire the rigid discipline which kept them in this unenviable situation for several minutes whilst they were in view of the Supreme War Lord, who stood on the bridge of the *Deutschland*. On the whole, the weather conditions were typical of the North Sea. Henceforth, as the maneuvers and the concluding parade have testified, the fleet of the Fatherland is to work out its destiny in the grey and turbulent water of the North Sea.—*Naval and Military Record.*

Touching the maneuvers themselves, the strategical and tactical operations performed, the incidents which attended them, and the issue of the mimic campaign, there is, as was to be expected, complete silence. In one important detail, however, they appear to have resembled the late British maneuvers, viz., in the almost complete absence of breakdown and minor mechanical defects. This, of course, apart from the unfortunate destroyer mishaps which occurred. The immunity of the high sea fleet from engine-room defects is due less to good luck than to the efficiency of the corps of naval engineers, and their subordinates, combined with a steadfast attention to duty which seems to have become a characteristic of this branch in all the great navies of the world.

No newspaper men were admitted so nothing is known as to the actual workings of the fleet. The endurance of the large torpedo-boats was exceptional, they keeping the sea in vile weather.

At the conclusion of the naval maneuvers the Emperor made the following wireless signal to the fleet:

"I express to the high seas fleet and the divisions attached to it for the autumn maneuvers of the coast defence forces my fullest acknowledgment for what they accomplished before me, and my warmest thanks for their diligent and faithful labor to increase our readiness for war."

The Lokalanzeiger announces that Admiral von Hollzendorff has consented to serve another year at the express wish of the Emperor.

ACCIDENT.—The German torpedo-boat *G 171* ran under the bows of the battleship *Zähringen* the afternoon of September 14 in the course of maneuvers southwest of Helgoland and was cut in two. Six men were drowned, and a seventh died soon after beng picked up from the water. The torpedo-boat sank at a spot where the water is 16½ fathoms deep, and will, it is expected, be raised. The *G 171* was launched in 1909, and belongs to the second torpedo-boat flotilla. She has reached a speed of 34.6 knots.

THE GERMAN FLEET LAW.—The new fleet law promulgated by Germany is of much interest. The argument states that the organization of the fleet suffers from two serious defects:

(1) In the autumn of each year all the time expired men—about one-third of the crew in all the ships of the battle fleet—are discharged and replaced by recruits that are mainly from the inland population. Owing to this the readiness of the battle fleet for war is considerably impaired for a considerable period; and

(2) That with an establishment of 58 capital ships *only* 21 ships are available at first if the reserve fleet cannot be made ready in time.

The law designs to relieve the first and second squadrons of the high sea fleet by giving six months training to every conscript before he is put into the absolutely first fighting line.

As regards the second defect we find that getting the reserve fleet ready for war in *proper* time becomes more and more unlikely owing to the ever-growing complexity of modern ships and of the steadily growing difficulty in training large organizations. At the present day, therefore, the reserve fleet can be considered only as a second fighting line, but in view of German strength in reserve men it still maintains its great importance.

Thus the logical way to remove both the defects is the formation of a *third active squadron* which will be done by this law.

The actual strength of the fleet will be 61 battleships and battle-cruisers, with 40 protected cruisters instead of 38. The fleet for service in foreign waters is to be composed of 10 first-class cruisers and 10 protected cruisers.

The increase in personnel requires an annual increase of 75 officers of all corps and 1600 men up to 1920.

The high sea fleet will now be composed of one fleet flagship, five squadrons of eight battleships each, 12 large cruisers, and 30 small cruisers.

Torpedo-boats are to be 144 with 99 in full commission.

The increase in battle-cruisers is four, and in small cruisers is six.

It is worth while noting that Germany has a mercantile marine of 533 steamers over 3000 tons displacement, with some of the finest and swiftest vessels in the world included in the list. These carry their guns and fittings in the holds and are manned by 64,000 seamen of whom a large proportion are reservists.

INCREASE IN BUDGET.—Additional funds will be demanded of the Reichstag in order to meet the expenses of the increase of men for the submarines. Furthermore a sum of 10 millions to demanded for reinforcing the defences of Cuxhaven, the batteries of which are to be rearmed with 12 and 15-inch guns.

INFORMATION FORBIDDEN.—Very little of the German fleet ever appears in print, the facts concerning it are always hard to obtain, and this condition is evidently to continue to an increased extent in the future. Judging from the following from *La Moniteur de la Flotte:*

"The Germans complain of the indiscretions of the journals and the press bureau has addressed to their publishers a circular letter demanding that they suppress news relative to new material, to inventions and to the equipment of the army and the fleet. The letter says that the publication of such news facilitates the task of foreign spies, and points out what news ought to be avoided in the future. 'For some time the characteristics of the German submarines which regularly ought to be confidential have been given. Only a short time ago a complete description of the new Erhardt gun was published, although it had just been bought by the authorities. In the public interest Prince Henry then took the gun, mounted it on board ship, and tested it, because in such a place no unauthorized people could see it. Such indiscretions, which all serve the enemy, ought to be avoided.' The letter closes by saying that the German press ought to be able to do as the foreign press does 'which publishes only rarely details on military subjects concerning their own country.'"

GREAT BRITAIN

VESSELS BUILDING

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Ajax	23,500	21	10 13.5-in., 16 4-in.	Scott (Greenock)	Launched March 21, 1912
Audacious	24,000	21	same	Cammel Laird (Birkenhead)	" Sept. 14, 1912
Centurion	24,000	21	same	Devonport	Completing trials
King George V	24,000	21	same	Portsmouth	Commissioned Nov. 16
Benbow	26,000	22	10 13.5-in., 16 6-in.	Beardmore	Laid down May 30, 1912
Delhi	26,000	22	same	Vickers	" May 31, 1912
Iron Duke	26,000	22	same	Portsmouth	Launched Oct. 12, 1912
Marlborough	26,000	22	same	Devonport	" Oct. 24, 1912
Qu'n Eliz'b'h*	30,000	29	10 14-in.	Portsmouth.	Keel laid Oct. 21, 1912
Warspite*	30,000	29	same	Devonport.	" " " 31, 1912
Battle Cruisers		28			
Princess Royal	27,500	28	8 13.5-in., 16 4-in.	Vickers	Commissioned Nov. 15, '12
Queen Mary	28,850	30	same	Palmer	Launched March 20, 1912
Tiger	28,850	25	same	Brown & Co.	Building
Australia	18,750	25	8 12-in., 16 4-in.	"	Launched Oct. 25, 1911
New Zealand	18,750		same	Fairfield	Completing trials
Protected Cruisers					
Chatham	5,500	25.5	8 6-in., 4 3-pdrs.	Chatham	Undergoing trials
Southampton	5,500	25.5	same	Brown & Co.	Completed trials
Dublin	5,500	25.5	same	Beardmore	Commissioned Dec. 1
Nottingham	5,400	25	10 6-in., 4 3-pdrs.	Pembroke	Laid down June, 1912
Birmingham	5,400	25	same	....	....
Lowestoft	5,400	25	same	....	" " July 28, 1912

*The other two battleships of the 1913 program have been designated the *Valiant* and *Barham*, and are to be built by Fairfield, of Glasgow, and Brown, of Clydebank, respectively. No details of these vessels are known as yet.

SHIPBUILDING.—The winter months will witness exceptional activity in naval shipbuilding, both in government and private yards. Under the Supplementary Estimates for the navy this year money was obtained for expediting new construction. All the destroyers, 20 in number, were ordered in the early spring, contracts for eight light-armored cruisers have recently been placed, and the laying down of the four large armored ships is to be expedited. For the first time on record a battleship has been laid down at Portsmouth within nine days of the launch of a battleship from the same slip. The first keel place of the new vessel was laid by Lady Meux on October 21, and it is stated that an effort will be made to launch her within four or five months. Usually a considerable interval takes place between the launch of one ship and the commencement of another on the same building slip, but in the present instance only one working week elapsed between the floating of the *Iron Duke* and the laying down on the same slip of the first armored ship in the 1912-13 program.—*Naval and Military Record.*

This vessel is probably to be an oil burner. She will have a partial installation of motor engines. The name *Trafalgar* is not unlikely, due to the date on which keel was laid. Length is to be 601 feet. This is the 33d battleship of the *Dreadnought* type.

The new British battleships just laid down under the 1912-13 naval program will not be launched until June next. It is understood that these ships will not be much larger than the *Iron Duke* and *Marlborough*. In addition to the ten 14-inch guns (compared with the 13.5-inch of the earlier vessels), a much higher speed, and better armor protection, the two new ships will carry a number of anti-air-craft guns, probably 4-inch. The mountings will

enable these guns to be elevated to 80 degrees, and a 31-pound shell will be used, with a charge sufficient to send a projectile to a height of 27,000 feet. The shell will be shrapnel, with a time fuse, and a bursting charge to scatter the fragments and bullets over a wide area.—*Shipping*, Illustrated.

H. M. S. "AUDACIOUS."—H. M. S. *Audacious* was launched on September 14 from the Tranmere yard of Messrs. Cammel, Laird & Co., Ltd. The launching ceremony was performed by Countess Lytton, who was accompanied by Lord Lytton. This vessel is the last of four battleships laid down under the 1910-11 program, the others being the *George V* (Portsmouth), *Centurion* (Devonport), and *Ajax* (Scott's). The vessels are 555 feet B. P. and 89 feet beam, with a load draft of 27 feet 6 inches, displacing over 23,000 tons. Parsons' turbines give a speed of at least 21 knots, with a S. H. P. of 31,000. The armament consists of ten 13.5-inch guns in five twin turrets of center line of ship, also sixteen 4-inch guns.—*Marine Engineer and Naval Architect.*

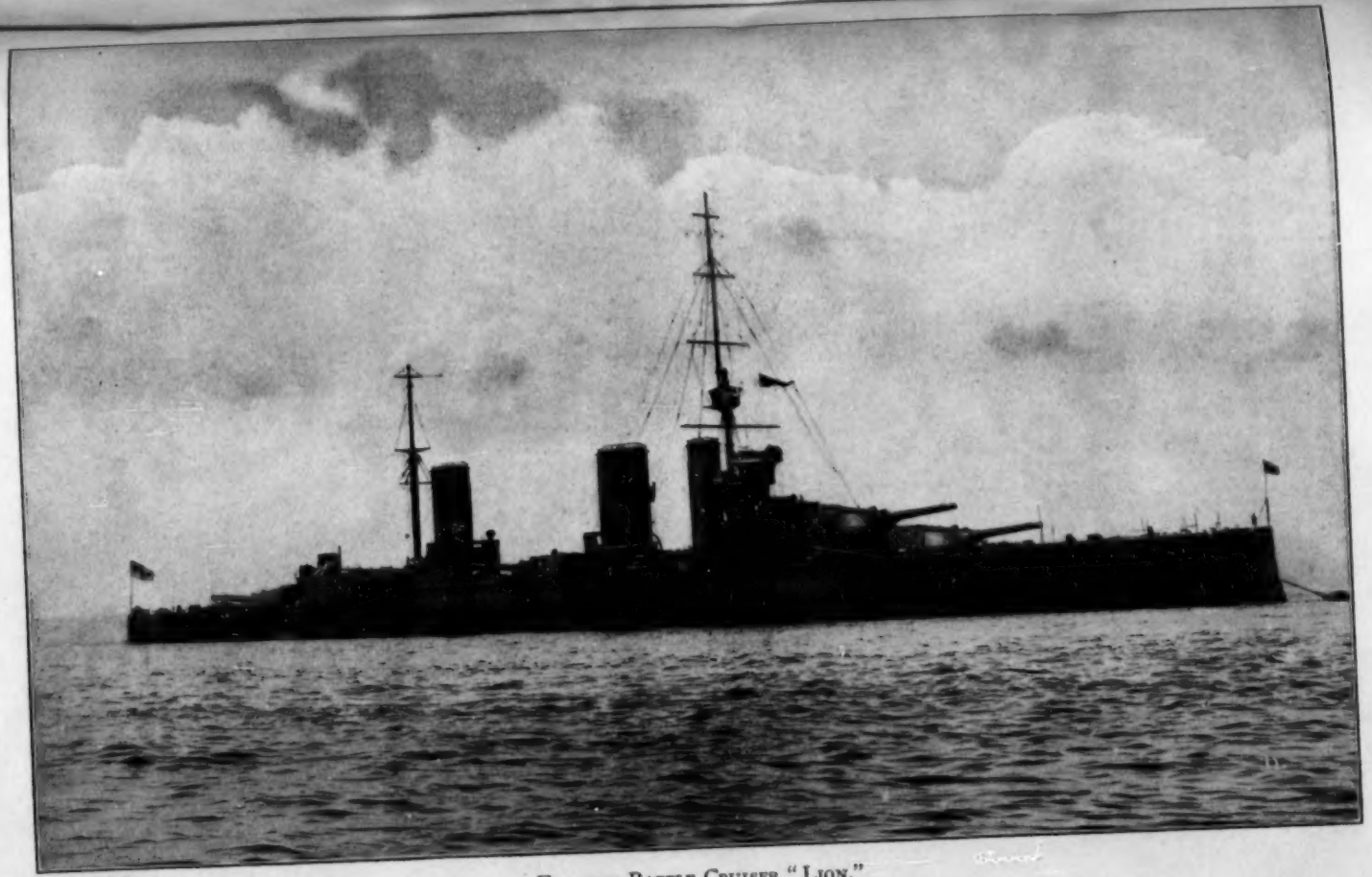
The *Audacious* is the 27th British ship of the *Dreadnought* type to go afloat, and, while the period spent on the stocks by the previous 26 vessels averaged only 10 months and a quarter, the *Audacious* will have been no less than 18 months on the slipway. The delay is accounted for by the builders having had various labor troubles to contend with, several sections of their workmen having come out on strike one after another and so dislocated the whole of the work in hand. The original contract date for completing the ship was January 16, 1913, but it is now probable that she will not be ready until nearly the end of that year.—*The United Service Gazette.*

NOTES ON THE "KING GEORGE V."—The officers are berthed aft. Her mast is stayed with wire rigging, the tripod type being discontinued. This vessel was commissioned November 16, or in less than two years after the laying down of her first keel plates. She has completed satisfactorily her 24 hours graduated steam trials. The ship was driven at a speed of over 18 knots hour after hour, against a heavy head sea, which at times broke over the forecastle in such quantities as to send the crest of the sea to the top of the navigating bridge. Out of this severe trial the controlling and securing fittings emerged most satisfactorily, while the behavior of the ship was such that it would have been possible to have fought every gun, if necessary.

The fire-control equipment of the *King George V*, provides for each barbette being individually fought, even though the mast may be wrecked by shell fire or the adjacent barbettes disabled, while during an action all changes of range, etc., would be conveyed direct to the sighting positions, thus enabling a continuous fire to be maintained. As all the guns are fired through electric generators, the risks of misfires will be reduced to a minimum.

The Whitehead torpedoes, of 21-inch diameter, are provided with range-firing directing instruments, a new and important innovation, which will ensure accurate runs being obtained, and as these instruments and the weapons themselves are provided with fittings which allow for changes of course of both ship and enemy, they may be classed amongst the most formidable yet installed. The preliminary trials of the magazine cooling appliances showed them to be thoroughly reliable under service conditions, the temperature of each of the magazines being satisfactory. The electric motors actuating the plant are of the newest design, and possess a good reserve of power.

THE "IRON DUKE" CLASS.—The four battleships of the *Iron Duke* class will each mount ten 13.5-inch guns of the latest Mark, and sixteen 6-inch quick-firing guns as secondary armament. This is a further advance in gun power, for whereas the main armament will correspond with that of the *King George V* class, the restoration of the 6-inch gun will give the *Iron Dukes* a superiority over all previous battleships of the *Dreadnought* era, which carry complements of either sixteen or twenty 4-inch guns as



Gibb, South Sea.

ENGLISH BATTLE-CRUISER "LION."

The *Princess Royal* is identical in appearance to the *Lion*.

Cribb, South Sea.

"KING GEORGE V."

Cribb.

BATTLE-CRUISER "NEW ZEALAND."

their secondary armament. The collective fire delivery of each of the *Iron Dukes* will be as follows:

Gun	No.	Weight of projectile	Total weight
13.5-inch	10	1,400 lb.	14,000 lb.
6-inch	16	100 lb.	1,600 lb.

The 6-inch guns will be placed in batteries well above the water-line and behind armor.

The external armor of the *Iron Dukes* will be carried well below the water-line to the crown of the gun-deck, and reinforced by internal armor over the vital parts, while to protect the hull below the water-line against submarine or torpedo attack an arrangement of sub-divisional bulkheads has been introduced.—*Naval and Military Record.*

This class of battleships is not to be "soft-ended," as at first designed. The armor belt is to be carried further forward and further aft until the soft-ends will be hardly appreciable. The other improvements in this class include an arrangement for the conning-towers to be used as control positions if the platforms up the mast are destroyed by gun-fire. The foremost tower of the two will be of an enlarged type, and the after tower will carry a control station for directing the gun-fire of the after turrets. All the turrets will, in accordance with recent practice, be on the middle line; the guns of the second foremost and the second after turret swinging their muzzles over the turrets in front of them, in training from one side of the ship to the other. The 4-inch guns for resisting torpedo attack are being placed in armored case-mates wherever possible, so as to give the gun's crew ample protection. The ship will not carry tripod masts, as her older sisters have done, and the funnels will not correspond to previous types. These will, altogether, be very formidable ships, showing another step in warship evolution.—*United Service Gazette.*

BATTLE-CRUISER "PRINCESS ROYAL."—This vessel is a sister ship of the *Lion*, a photograph of which ship is produced herewith.

The new British battle-cruiser *Princess Royal*, was constructed and engined by Messrs. Vickers, Ltd., Barrow-in-Furness, and was launched on April 29, 1911. She is 660 feet long, 88 feet 6 inches beam, and on a draft of 28 feet has a displacement of 26,350 tons. The armament embraces eight 13.5-inch breech-loading guns mounted in pairs in barbettes on center line. The 4-inch guns are disposed behind armor. The turbines are of the Parsons' type, driving four shafts and four screws. There are two high-pressure and two low-pressure ahead turbines, and a corresponding arrangement of astern turbines.

In arranging the program of official trials for the battle-cruiser *Princess Royal*, just completed by Messrs. Vickers (Limited), Barrows-in-Furness, the Admiralty have departed from the practice followed for many years by deciding that the vessel's gunnery, and torpedo trials should precede the tests of her propelling machinery. So far as can be seen at present, there is no reason to regret the change, for the gunnery and torpedo tests, which were commenced on September 7 and concluded on September 8, are reported to have been completely successful.

To torpedo trials on September 7, exceptional interest attached, owing to the fact that for part of the time that the vessel was steaming up and down the Channel, after leaving Cawsand Bay in the morning, the Admiralty required torpedoes to be discharged while the battle-cruiser was at full speed. Special care is being exercised to prevent details as to the vessel's steaming becoming public, but inquiries leave no doubt whatever that while travelling at full speed, as well as during the remainder of the day, she behaved splendidly. Except when she was turning, there was almost an entire absence of vibration, and it is stated that she attained a speed of between 30 and 31 knots.

She returned to Plymouth on the evening of the 12th on completion of her eight hours full-power trial in the Channel. This trial is the most exacting of the whole program of official tests, but the vessel, as was anticipated, came through the ordeal with results which must be exceedingly gratifying to the contractors (Messrs. Vickers, Limited). The full-power trial necessitated the maximum power for which the vessel was designed, namely, 70,000 horse-power being maintained for the full eight hours. It is understood that this was done with ease, the engines not being put to their full test, and, consequently, it is impossible to state the highest speed which the vessel may be capable of attaining. In fact, it is stated that steam was being let off continually throughout the trial. Therefore, it might be assumed that when her speed tests take place, she will lower the colors of her only sister ship, the Devonport-built *Lion*. The engines of the two vessels are by the same firm.

It was after taking in upwards of a thousand tons of coal that the *Princess Royal* left the Sound about six o'clock on that morning. The required speed was quickly reached, and the trial included some half-dozen runs over the measured mile course off Polperro. Several subsidiary trials were to have been carried out at the conclusion of the eight hours test, but these had to be curtailed and only the circle trials were completed. Her speed was 31.7 knots for the eight-hour trials. Horse-power between 80,000 and 90,000. The *Princess Royal* went into the Channel again on next day for starting, stopping, reversing, steering, and astern trials. On completion of these she returned to Plymouth and subsequently went up harbor preparatory to being placed in No. 8 dock at the North dockyard.

While in this dock—and it is interesting to note that this is the dock that was lengthened to accommodate the *Lion*—her propellers were changed. She remained in dock until September 18. Upon all her trials the behavior of the new battle-cruiser as a sea-boat, has been all that could possibly be desired, but it must be admitted that all the tests have been carried out under most favorable weather conditions. In the full-power trial on September 12, it was especially noticeable that the engines worked most smoothly, the only vibration being a steady, gentle throbbing, this being chiefly felt in the after part of the ship over the propellers. While trials of this kind are in progress the stokers usually get a hot and tiring time in the stokeholds feeding the huge furnaces, but their task on September 12 is stated to have been comparatively comfortable.

The vessel again left Plymouth Sound on September 13 for subsidiary tests, which included starting, stopping, reversing steering, circle, and astern trials with satisfactory results. The vessel returned to Plymouth in the afternoon and anchored in Cawsand Bay. She went into harbor on September 14.

The improvements embodied in the *Princess Royal*, as the result of the experience gained in the *Lion*, have fully justified the delay in completing the new ship. The interference with the control fittings which was a feature of the *Lion's* trials—with the foremost funnel in front of the mast—has now disappeared as the result of the removal of the funnel abaft the mast, while the lengthening of the three funnels by ten feet and their enlargement has reduced the flaming and over-heating to a minimum.

New propellers were fitted to the vessel in deck, and in further trials in the Channel on September 21 she attained the speed of 34.7 knots. Under natural draft average speed was 29 knots, and an average of six runs under full power gave 33 knots speed.

The weather was unusually good for these trials, and this fact contributed to her exceeding the *Lion's* speed.

The figure 34.7 may be excessive, but it has been creditably reported, though the *Naval and Military Record* says the following:

"The London correspondent of the *Yorkshire Post* says: The greatest secrecy is being maintained by the Admiralty regarding the result of the full-power trial of the *Princess Royal*, but I am credibly informed that, as

I anticipated, the maximum speed exceeded 32 knots—to be exact, 32.4, nearly a full knot in excess of the record made by her sister ship the *Lion*. The engines are declared to have developed between 80,000 and 90,000 horse-power at one period of the eight hours trial, compared with their designed horse-power of 70,000. It must be taken into account, however, that the trial was carried out under unusually good weather conditions. There were no such stormy seas as those through which the *Lion* had to plough when undergoing similar tests."

A new set of four-screw propellers has been fitted, and she will carry out a series of trials exactly corresponding to those now so satisfactorily terminated. The idea (says *The Times*), is to ascertain the effect on speed of propellers of different proportions in order that the same high efficiency may be realized from propellers as from the other parts of the mechanism. It is well known that knowledge is less definite as to propellers than as to other factors in ship propulsion, and the Admiralty decided that a thoroughly practical test should be made with both the *Lion* and the *Princess Royal*, sister ships. In the case of the *Lion*, new propellers were tried after the vessel went into commission; in the *Princess Royal* the trials are to be made at once. Thus the Admiralty will have data for four sets of propellers, with the minima of variation in other factors, since both ships and propelling machinery are alike. The *Lion*, although built at Devonport, was supplied with her machinery from Vickers' works, where the jig and gauge system adopted ensures absolute precision, and thus the machinery is exactly the same, which makes possible accurate deduction between the performances of the ships. It would be imprudent to state with any detail the results so far of this experiment, but, satisfactory as was the performances of the *Lion*, these have been exceeded by the *Princess Royal* to the extent of one nautical mile per hour at full power.

"NEW ZEALAND."—The trials of this vessel began on October 9. A complete program of her trials is of interest and is given:

The trials September 28. The ship is to leave Greenock on September 29, arriving at Devonport on the 30th. From October 1 to October 9 she will be in dock. She will then begin her 30-hours trial, and anchor in Plymouth Sound on October 10. She arrives at Spithead on October 14, and will carry out steering and circle trials on the 15th; from the 16th to 19th air compressor trials, torpedo and gun drills; on the 21st gun trials; and on the 22d torpedo and anchor trials. The vessel will leave for Fairfield on October 23, carrying out magazine and cooling trials on the way north.

This battle-cruiser was built at the order of the New Zealand Government at the Fairfield Shipbuilding Co., Govan, and has been donated by New Zealand to the English Admiralty. The reports to date of her trials give her attained speed as 27 knots.

This vessel, built by the Dominion of New Zealand originally for her navy, has been presented by the people of the Dominion to the Admiralty in order to show their patriotism and their belief that all parts of the empire have a common interest in maintaining English naval supremacy. She may be employed when and where the Admiralty pleases.

NEW PROTECTED CRUISER.—The second-class protected cruiser *Sydney*, just launched, is one of four provided for under the 1910-11 program, and is being built to the order of the Australian Commonwealth by the London & Glasgow Engineering & Iron Shipbuilding Co., Ltd., Govan. These vessels are light unarmored ships intended for reconnaisance work in association with the more powerful armored cruisers of a fleet. Being possessed of a speed of 26 knots, they should prove most serviceable. They are not intended to penetrate the screen of the enemy's force, and the armament is therefore limited to 6-inch bow and stern chasers, three 6-inch guns on each side, four 3-pounders, and a few smaller guns. They also carry two

submerged tubes for 21-inch torpedoes. They may be regarded as developments of the *Town* class, and whereas the horse-power developed in the *Town* class was 22,000, the *Sydney* will develop 25,000. In addition to this power advantage the *Sydney*, though being the same length between perpendiculars as the *Town* class (viz., 430 feet), has a breadth extreme of 49 feet 10 inches, against 48 feet 6 inches, a mean of draft of 15 feet 9 inches, against 15 feet 6 inches, and a displacement in tons at load draft of 5400, against 4800. The safety of the vessel in the event of damage being sustained has been well provided for, the vessels being subdivided into numerous water-tight compartments. Additional protection is afforded by water-tight coal bunkers, which extend along each side of the vessel. The magazine and shell rooms are lighted and ventilated on the latest system, and kept at a low, even temperature by special refrigerating plant provided for the purpose.

The Sydney's Machinery.—In general appearance the Sydney will resemble the *Yarmouth*, launched by the builders last year, the main difference being, continues the *Morning Post*, that in the new vessel the forecastle extends for about two-thirds the vessel's length, which forms a boat deck and provides additional accommodation for officers, crew, storerooms, etc. She has two masts, both fitted with yards, for wireless telegraphy and signalling, the foremast also carrying a fire control platform The funnels are four in number. A belt of protective plating is carried right fore and aft, extending from the upper deck to well below the waterline. The vessel will be electrically lighted throughout and fitted with four searchlights, electrically driven coaling winches, ammunition hoists, fresh and salt water pumps, and ventilating fans. A complete system of voice pipes, telegraphs and telephones, and a submarine sound signalling apparatus will be installed. The turbine machinery driving four propeller shafts is contained in three separate engine rooms abreast, the main condensers and auxiliary machinery being in two compartments directly aft of the main engine rooms, while the 12 water-tube boilers are placed in three separate boiler rooms. The double bottom which extends under the machinery spaces and the forward and after magazines is sub-divided into numerous compartments, some of which are used for carrying oil fuel and reserve feed water for boilers. The propelling machinery is of the Parsons' turbine type of 25,000 shaft horse-power at 500 revolutions. When going ahead all shafts revolve outwards. The propellers (four in number) are of manganese bronze. The main steam and maneuvering gear for all turbines is arranged on the forward bulkhead in the center engine room. There being no cruising turbines a special series of blades for cruising purposes are fitted in each high-pressure turbine. The boiler rooms are adapted for use with the closed stokehold system of forced draft, the supply of air being provided by steam-driven fans. Oil pumps are provided for both oil fuel and forced lubrication purposes.—*Page's Weekly.*

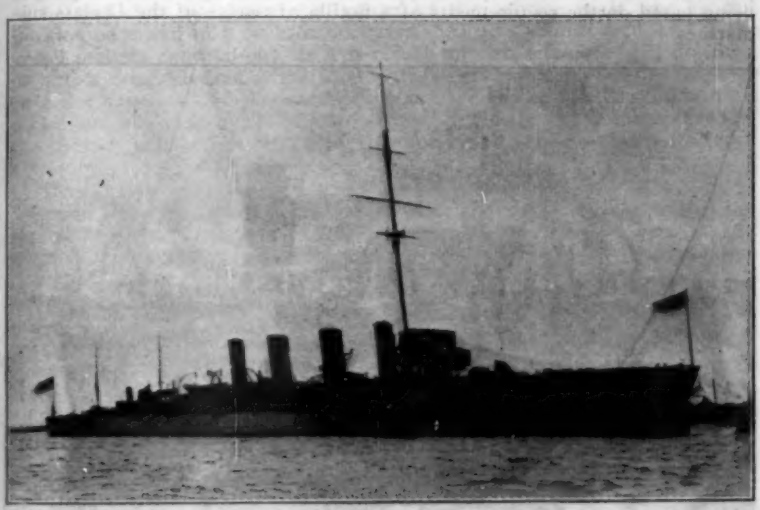
LIGHT ARMORED CRUISERS.—Orders have just been provisionally placed by the Admiralty for four light armored cruisers, two with Messrs. Vickers (Limited), Barrow-in-Furness, and two with Messrs. W. Beardmore & Co. (Limited), Dalmuir. Two others of the eight in this year's program are to be built at Chatham and Pembroke respectively.

Mr. Churchill said on March 18 last that these cruisers "will be the smallest, cheapest, and fastest vessels, protected by vertical armor, ever projected for the British Navy. They are designed for attendance on the battle fleet, to be its eyes and ears by day and night, to watch over it in movement and at rest. They will be strong enough and fast enough to overhaul and cut down any torpedo-boat destroyer afloat."

It is understood that five of the new light-armored cruisers are to have Parsons' turbines and three Brown-Curtis turbines. The Parsons' ships will be Messrs. Beardmore's three and Messrs. Vickers' two. Fairfield's ship is to have Brown-Curtis turbines, and so are the two ships which are

to be built at Chatham and Pembroke respectively. The contractors for the machinery of the dockyard ships are the Thames Ironworks Company.

Orders have been given that the sick bay fittings of all new ships are to be inspected by an officer from the department of the Medical Director-General immediately after the completion of the steam trials. The sick bay and medical distributing stations are to be completely fitted up prior to a new ship proceeding on her steam trials. At the conclusion of the steam trials, and before the medical officer borne for the trials leaves the ship, arrangements are to be made for the inspection of the sick bay and medical distributing stations by an officer from the department of the Medical Director-General, so that the experience of the medical officer during the steam trials may be obtained by the inspecting officer and to ensure that the arrangements fitted are satisfactory.—*Naval and Military Record.*



Cribb.

ENGLISH SCOUT CRUISER "ACTIVE."

THE "ACTIVE."—This is one of a class of three scouts to be completed in 1912, the others being the *Amphion* and *Fearless*. Their displacement is 3360 tons, length 385 feet, beam 41½ feet, draft 14 feet. Armament is ten 4-inch guns, with two above-water torpedo tubes. Speed is 25 knots. Boilers are Yarrow. Engines are Parsons' turbines.

H. M. S. *Lurcher*, one of the torpedo-boat destroyers of the *Firedrake* type, attained during a continuous run of eight hours the mean speed of 35.34 knots, thus exceeding the contract speed of 32 knots by 3.34 knots. The vessel is 255 feet long by 25 feet 7 inches beam, and is propelled by Parsons' turbines, driving two shafts, the steam being supplied by three Yarrow water-tube boilers fitted with that firm's latest feed-heating device. The *Lurcher* is thus one of the fastest destroyers that has ever been built, and is an important addition to the British Navy.

The British torpedo-boat destroyer *Hardy*, has been launched from the Thoryncroft yard, near Southampton. She is the first destroyer belonging to the British Navy to be driven by Diesel oil engines. The vessel, which has been designed to do 32 knots, will use turbines for her full speed, but

the value of the oil engines will be found at moderate cruising speeds, in which it is considered to be certain that they will make for both economy and efficiency. The *Hardy* was laid down less than a year ago, and it is likely that she will be delivered to the Admiralty in about two months.—*Shipping*, Illustrated.

NEW DEPOT SHIP FOR SUBMARINES.—The *Maidstone*, the first specially designed depot ship for submarine vessels, was commissioned on October 4. The *Maidstone* has been fitted out on the experience gained in the several converted depot ships which have preceded her.

The principal dimensions and equipment of the ship are as follows: Length, 320 feet; beam, 45 feet; displacement, 4000 tons; speed, 15 knots; coal capacity, 600 tons; oil capacity as fuel, 550 tons; for lubricating purposes, 50 tons. There are special appliances for handling the oil, the quantity being based on the requirements of a flotilla of twelve of the *D* class submarines.

Cribb.

SUBMARINE SALVAGE VESSEL.

The equipment of the *Maidstone* consists of large storerooms for the spare parts of machinery, torpedoes, and their explosive war-heads, primers, etc.; a dynamo room, with four sets of the new type turbo-generating machinery, the first of its kind to be supplied to the British fleet, and powerful air-compressing plant for use in charging torpedoes, etc. The workshop and machinery plant comprises (a) engineering workshop provided with the latest lathes, cutting, planing tools, etc., with an annex for dealing with torpedo defects; (b) a smithery for forging, welding, and other work; and (c) a foundry capable of handling brass, steel, and other metal castings.

The *Maidstone's* berthing arrangements, which provide excellent accommodation for 40 officers and 450 petty officers and men, are calculated to secure the comfort of the crews when off duty in the submarines. The sick quarters, canteen, culinary, bakery, and general internal equipment are admirably fitted. Electric searchlights also form part of the outfit, and the vessel is efficiently lighted with electric lamps, special fittings being provided for the workshops, medical examinations, and for oiling and coaling purposes, etc., by night.—*Naval and Military Record.*

THE SALVAGE OF SUBMARINES.—The new salvage craft which has recently been completed for the navy appears to be an effective vessel for the work she is intended to perform, viz., the lifting of sunken submarines. A salvage vessel is required which can speedily be got into position for lifting, in all moderate weather, and which, when the lift has been made, can be towed to the nearest dock with the submarine still in the slings, and there deposit its burden for repairs. It is believed that this latter function will be readily performed by the new vessel (several sisters of which are being ordered), as she is 160 feet long and 44 feet broad, and has a lifting capacity of 1200 tons, whereas our heaviest projected submarine does not exceed 1000 tons displacement. The vessel, which cost $204,120, is fitted with two powerful electric capstans on the forecastle and stern respectively, and is so shaped underneath that a submarine can, by means of large chain slings, be hoisted close up under the bottom of the salvage craft, and in this position be towed to a dock or dockyard. All this sounds well, and if the vessel realizes expectations, as it is confidently expected she will do, then, at last, a great modern naval want will have been filled, which stands to save the navy tens of thousands of pounds. The sooner a submarine is raised and placed in dock the less harm will be done to her machinery and the cheaper will be her repair for further active service.—*United Service Gazette.*

SPEEDY COALING.—While coaling at Portland in October the *Neptune* established a world's "record" by taking in 650 tons in one hour and 25 minutes, an average of 458.8 tons per hour. All the coal was taken from lighters. During her commission the *Neptune* has established a reputation for smart coaling. Before this week's performance her best average was 403 tons per hour.—*The Army and Navy Gazette.*

ENGLISH AND GERMAN SHIPBUILDING.—England puts on the stocks in 1913 5 battleships to Germany's 3; in 1914, 4 to Germany's 2; in 1915, 4 to Germany's 2; in 1916, 4 to Germany's 3; in 1917, 4 to Germany's 2. This will make 56 English battleships opposed to 35 German battleships.

THE NEW ADMIRALTY FLOATING DRY DOCKS.—On page 1130 of PROCEEDINGS No. 143 will be found a complete description of a 32,000-ton floating dock for the English Admiralty constructed by Swan, Hunter & Wigham Richardson at their works at Wallsend. This dock has been towed to and is located in the river Medway.

An illustration is here given of another dock, a sister to the above, which arrived at Portsmouth August 21, 1912. This dock was built at Birkenhead by Messrs. Cammel, Laird & Co., and the photograph shows the dock arriving in Portsmouth harbor.

The Medway dock was towed from the Tyne to the Medway by foreign tugs. The towage of the Portsmouth dock, however, was given to Liverpool tugs, although the trip was a longer and more strenuous one than in the case of the East Coast dock. The dock left the Mersey on August 14, and the weather, during the trip to Portsmouth, was a continual succession of gales. The best speed made was five miles per hour when the wind and sea were directly astern. The entrance of the dock into the harbor was a difficult undertaking, considering the intricacy of the narrow channels and the various turns that had to be made before the huge structure had been safely berthed in Fountain Lake. That a vessel 700 feet long, with walls 60 feet high above the water-line, and covering an area of two and a quarter acres, should have been brought in so successfully without touching any of the banks is considered a smart piece of management.

The berth for the new dock is alongside the end of the jetty in Fountain Lake that has been built out from the dockyard wall. This jetty, which is 124 feet in length on the face, and 143 feet from front to back, is carried on cast-iron cylinders, sunk into the clay at the bottom of the lake, and filled with concrete. It is constructed of ferro-concrete, and is provided with a superstructure of heavy steel work and railway communication from the dockyard, so that material for the repair of ships can be taken alongside the dock.

Cribb.

"BIRKENHEAD," FLOATING DRY DOCK.

The following table is of interest relative to floating dry docks. The number of greater docks built since the *Dewey* is thus considerable:

PARTICULARS OF SOME OF THE LARGEST FLOATING DOCKS IN THE WORLD.

Dock	Lifting capacity	Length	Clear width	Depth over keel blocks	Owners
	Tons	*Feet*	*Feet*	*Feet*	
Kiel	40,000	656	154	35½	German Government
Hamburg	35,000	720	108½	33	Blohm and Voss
Medway	32,000	680	113	36	British Admiralty
Portsmouth	32,000	680	113	36	British Admiralty
Montreal	25,000	600	100	27½	Canadian Vickers Ltd.
Hamburg	25,000	525¾	108½	33	Vulcan Company
Pola	22,500	584¾	111½	37	Austro-Hungarian Govt.
Rio de Janeiro	22,000	550	100	30	Brazilian Government
Hamburg	20,000	511½	97	26	Reiherstieg Company

DOCKING TEST.—The final lifting trial of the *Dreadnought* dock built by Swan, Hunter & Wigham Richardson, Ltd., Wallsend-on-Tyne, for the British Admiralty, took place in the river Medway on Wednesday, October 2, when the battle-cruiser *Lion*, displacing 30,415 tons and drawing 31 feet

6 inches of water, was successfully docked and lifted. The actual lifting operation of the dock from a draft of 31 feet 6 inches until the pontoon deck was awash at the sides occupied three hours and ten minutes. The total distance through which the vessel was lifted was 36 feet and the total quantity of water necessary to be pumped in order to raise the deck of the dock clear of the water was about 46,000 tons. After H. M. S. *Lion* had been cleaned and painted and some necessary repairs had been effected, the dock was lowered the following morning at 8 o'clock and the ship was undocked during the day. The operation of lifting this hugh battle-cruiser was one of the greatest interest, as no ship of a similar displacement has ever been lifted out of the water by a floating dock. The time occupied in lifting the vessel was well within the limits prescribed by contract.

ADMIRALTY ORGANIZATION.—On September 7, the Admiralty issued a memorandum defining minutely how business was to be transacted in the Department. The change consists in adding the following to the organization shown on page 328 of No. 141 of the PROCEEDINGS:

An additional civil lord who does the duties of our paymaster-general relative to the supplies of the fleet.

A financial secretary who handles the accounts business of what corresponds to our Bureau of Supplies and Accounts, and

A permanent secretary to look out for general office organization.

The First Sea Lord, who corresponds to our Aid for Operations, is always to be consulted in matters of great importance by the other sea and civil lords and the secretaries.

THE NEW CHIEF CONSTRUCTOR.—The difficulty about Sir Philip Watts' successor has now been solved by the appointment of Mr. Tennyson d'Eyncourt to the chair of the chief constructor, and thus the Elswick record is carried on. Mr. d'Eyncourt was trained by and worked with Sir Philip in Newcastle, and though he left Armstrong's and worked at Fairfield for a few years, he has for some years past been working, rather side by side, than under Mr. Perrett. He is still a comparatively young man, but he has a wide knowledge of warship building and is universally respected as a designer. He has also, we believe, very definite opinions of his own, and we fully expect to see him carry on the brilliant record of the chief constructors who have preceded him at the Admiralty. The only qualification for the post in which, as far as we are at present aware, he is lacking is that he is not a member of the Royal Corps of Naval Constructors. It has been urged in some quarters that for that reason he should not have been appointed. This we cannot admit. If he was the man best fitted for the post that could be found no sentimental objection of that kind should have weight. For the time being Sir Philip Watts is assisting Mr. d'Eyncourt to pick up the threads at the Admiralty, but it is an open secret, if a secret at all, that when he severs his connection with the Admiralty he will join the board of Armstrongs. We are delighted to have to put on record also that Mr. W. H. Whiting, for many years the chief assistant constructor, has been elected to fill the post of superintendent of construction accounts and contract work, vacated by the retirement of Sir William Smith. All who know Mr. Whiting and the work that comes under the long title he now enjoys will recognize how fully he merits the appointment, and how well fitted he is to receive it. We may add that his late position is now filled by Mr. W. J. Berry, till lately chief constructor at Malta.—*The Engineer.*

An appointment at the end of July was made of a committee to inquire into the use of oil for naval purposes, Lord Fisher being chairman, with Sir Philip Watts, Sir John Jellicoe, Sir Henry Oram, and Mr. A. F. Yarrow as prominent members. The errors in design and consequent delay in the completion of the *Lion* are understood to have been largely responsible for the changes made in the distribution of business at the Admiralty.

Within the next month great fleets will be assembled in the Mediterranean. In view of the situation created by the war in the Balkans the Admiralty are expediting their plans for reasserting British power in these waters. Not only has the third battle squadron, consisting of the eight *King Edwards'* arrived at Malta, but the battle-cruiser *Inflexible* and the armored cruiser *Warrior* are to proceed to the Mediterranean early in November as permanent additions to Admiral Sir Archibald Milne's command. By the end of the year the *Indomitable* will also have reached the Mediterranean, and we shall then have a force of eight battleships, two battle-cruisers, and four armored cruisers in those waters. In the past few days the six battleships of the third squadron of the French fleet have left Brest for Toulon, and practically the whole of the French fleet will this winter be concentrated in the Mediterranean, Admiral de Lapeyrère having under his command no fewer than eighteen battleships and six large armored cruisers. If we count the British battle-cruisers as swift battleships, which, of course, they are, the Double Entente will possess twenty-eight battleships and ten armored cruisers in the Mediterranean during the winter months. These forces should be sufficient to prevent the Mediterranean becoming the scene of serious trouble, for the Italian and Austrian fleets, even if—which is exceedingly improbable—they were ordered to combine, would be very inferior to the ships under the White Ensign and the Tricolor, *i. e.*, the *King Edward VII, Zealandia, Hindustan, Africa, Hibernia, Britannia, Commonwealth,* and *Dominion.—Naval and Military Record.*

ENGINEERING INSTRUCTION.—The Admiralty have decided that the Royal Naval Engineering College, Devonport, which has been closed for more than two years, shall be reopened on October 1, 1913, when the first party of "Lieutenants, E.," who joined the navy under the system of common entry inaugurated in 1902, will be transferred from seagoing ships to the college for a course of special training in engineering.

NAVAL GUN ACCIDENT.—A serious gun accident occurred on board the battleship *King Edward VII* off Colonsay on September 26, resulting in one man being killed and several injured. It is stated that the mishap occurred during firing practice, the breech-block of one of the larger guns being blown out and falling among a number of men.

SUBMARINE "B 2" SUNK.—The *B 2* was one of the older and smaller class of submarines, having been built, with 10 sister ships, between the years 1903 and 1907. Her length was 100 feet and her beam 12 feet 7 inches. Her displacement on the surface was 180 tons and submerged 210 tons. Her indicated horse-power was 600 on the surface and 150 below. Her engines developed a speed of 11½ knots on the surface and 8 knots submerged. She was fitted with two torpedo-tubes, and her complement was 2 officers and 13 men.

B 2 left Dover harbor about 5.30 on Friday, October 4, to participate in tactical exercises in the Channel. She was followed half an hour later by *C 16*, which was bound for the same destination as *B 2*. The latter was steaming on the surface with all navigation lights showing, and steering a course E. S. E., when she was run into by the Hamburg-American liner *Amerika* coming from the northeast. The liner struck the submarine just before the conning-tower, and probably cut her in two. She sank at once. The only member of the crew saved was Lieutenant Pulleyne, who was picked up by *C 16* after he had been swimming from half to three-quarters of an hour. Fifteen lives were lost.

The disaster was not witnessed by any of the other vessels of the torpedo or submarine flotillas, which had been exercising from Dover during that week. The liner appears to have stopped and lowered boats, and she afterwards proceeded on her course westward. The collision was not due to any mistake on the part of the submarine, which could have been seen some

distance away, as it was getting daylight. Lieutenant Pulleyne was brought to Dover and placed on board the cruiser *Forth* by *C 16*.

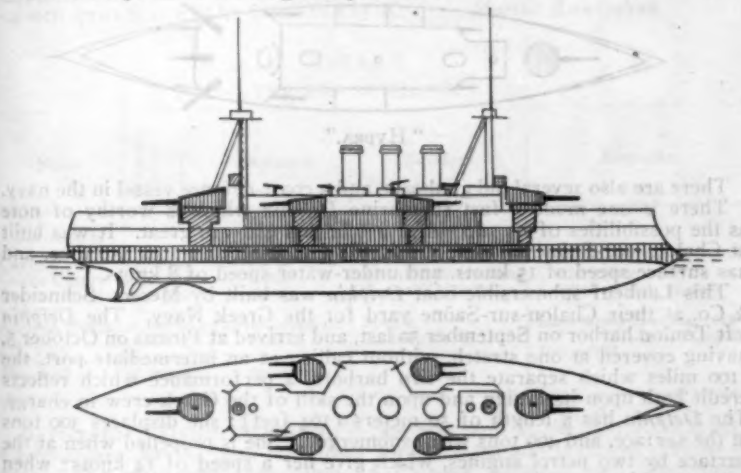
Searching operations were at once commenced by several vessels of the flotillas and by tugs from Dover. The naval authorities located the wreck on Sunday night, the sweeping gear of the destroyers *Leven* and *Fairy* catching it, whereupon divers were sent out from Dover for the purpose of going down to ascertain its exact whereabouts, notwithstanding the strong tide they succeeded in fastening a wire hawser to the submarine. Later, after attempts to raise her had been unsuccessfully made, the Admiralty definitely abandoned the attempt.

Lieutenant Pulleyne was on deck at the time of the collision, and the only other person there was a coxswain, but after the submarine was cut down Lieutenant Pulleyene did not see him again. The liner was going 18 knots at the time.

SUCTION AS CAUSE OF THE DISASTER.—Among naval men there is a very strong opinion that the disaster was due to suction. The enormous displacement of water by a 23,000-ton liner like the *Amerika*, they state, affects vessels of far greater size than a submarine, by influencing the steerage way. The tendency they say is very noticeable for torpedo-craft to veer towards larger warships owing to suction force when they are within a certain distance.

GREECE.

The Greek Navy, though less on paper than the Turkish, is in reality quite as powerful. Its ships are as a rule more modern and, rumor has it, in better shape as to training and personnel.



"GIORGIO AVEROFF."

The best Greek ship is the armored cruiser *Giorgio Averoff* of 10,000 tons, speed of 23 knots, launched at Leghorn in 1910. The main battery is four 9.2-inch guns, eight 7.5-inch, sixteen 3-inch, and three submerged tubes.

There are three small battleships, the *Hydra*, *Psara*, and *Spetsai*, built in France in 1892, and having several good points, not the least of which is their small draft, but 20 feet on a displacement of 5000 tons. M. Dupont, a young engineer, was their designer. Main armament is three 10.6-inch guns, five 5.9-inch and three torpedo-tubes.

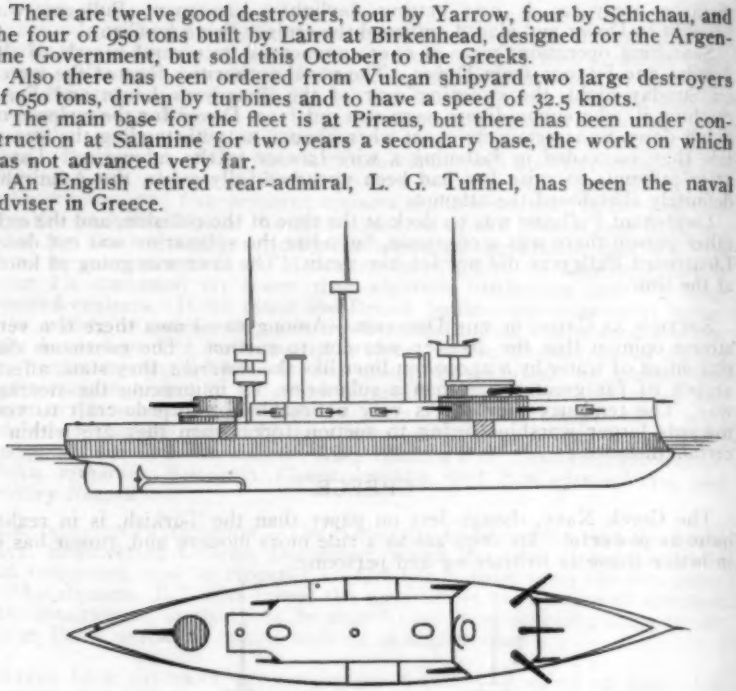
The unusual mounting of these guns is shown in diagram on p. 1654.

There are twelve good destroyers, four by Yarrow, four by Schichau, and the four of 950 tons built by Laird at Birkenhead, designed for the Argentine Government, but sold this October to the Greeks.

Also there has been ordered from Vulcan shipyard two large destroyers of 650 tons, driven by turbines and to have a speed of 32.5 knots.

The main base for the fleet is at Piræus, but there has been under construction at Salamine for two years a secondary base, the work on which has not advanced very far.

An English retired rear-admiral, L. G. Tuffnel, has been the naval adviser in Greece.



"HYDRA."

There are also several old gunboats, and a coast-defence vessel in the navy.

There is one modern fast submarine *Delphin* which is worthy of note as the possibilities of its successful use in this war are great. It was built at Chalons-sur-Saône in 1911, and is 164 feet long, displaces 450 tons, and has surface speed of 15 knots, and under-water speed of 8 knots.

This Laubeuf submersible boat *Delphin* was built by Messrs. Schneider & Co. at their Chalon-sur-Saône yard for the Greek Navy. The *Delphin* left Toulon harbor on September 30 last, and arrived at Piræus on October 5, having covered at one stretch, without calling at an intermediate port, the 1100 miles which separate the two harbors, a performance which reflects credit both upon its design and upon the skill of the Greek crew in charge. The *Delphin* has a length of 50 meters (164 feet); she displaces 300 tons at the surface, and 460 tons when submerged. She is propelled when at the surface by two petrol engines, which give her a speed of 14 knots; when submerged her two electric motors give her a speed of 9 knots. She has a radius of action of 1800 miles, and carries four torpedo-launching tubes on deck and one astern for 450 mm. (17.7-inch) torpedoes.

There are three mine-laying vessels of 3000 tons displacement.

On October 11 the government purchased the *Chao-Ho*, recently completed at Elswick for a Chinese training ship. She has a displacement of 2750 tons, and is armed with two 6-inch, four 4-inch, and two torpedo tubes.

BUDGET, 1912-1913.—The Greek shipbuilding program comprises work which will cover three years, and provides for the building of a sister vessel of the *Giorgio Averoff*, the reconstruction of the old armorclads *Spetsai*,

Psara, and *Hydra*, the purchase of two submarines, and the increase of the torpedo flotilla. The contract for the armored cruiser has been secured in Germany, which fact is likely to cause some disappointment in Italy. The *Averoff* was built at the Orlando yard, Leghorn, where the shipbuilding facilities have since been largely increased. She was a great success, and the fact that the contract for her successor has gone to a German yard is no doubt due to severe competition in price. It is believed that one submarine of the *Argo* type will be built in Italy, and another at the Germania yard. The amount to be expended on the torpedo flotilla is £360,000, and probably four destroyers of 650 tons, and six 200-ton torpedo-boats will be built. Two of the destroyers and the six torpedo-boats have been ordered at the Vulcan yard.—*The Army and Navy Gazette.*

Greek torpedo-boat No. 11 has sunk the 2700-ton armored corvette *Feth-I-Bulend*, in Salonica harbor.

HOLLAND.

The two Dutch colonial torpedo destroyers *Jakkhals* and *Bulhond* have been commissioned for service in the Dutch East Indies.

The Dutch surmarine *No. III* was launched July 30.

The four torpedo-boats building at Vlissingen and Rotterdam are named *Lynx*, *Hermelyn*, *Bos*, and *Panter*. The armored gunboats building at the government yard at Amsterdam are named *Brino*, *Friso*, and *Gruno*.

It is reported that a Dutch naval commission has visited England to contract for building four small *Dreadnoughts* for Holland of 17,000 tons displacement. The details are not yet known, but they are to have eight 12-inch guns that will be furnished by Krupp.—*Marine Rundschau.*

ITALY.

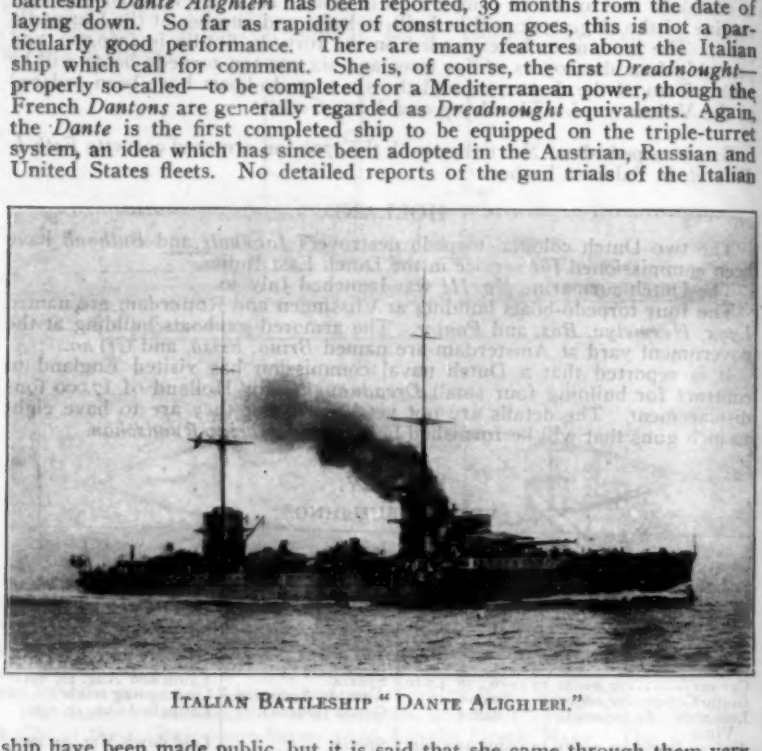
VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Cavour.....	22,000	22	13 12-in., 18 4.7-in.	Spezia	Launched Aug. 10, 1911
Giulio Cesare..	22,000	22	same	Ansaldo-Armstrong	Undergoing trials
Leonardo da Vinci	22,000	22	same	Genoa (Odero).	Launched Oct. 14, 1911
Andrea Doria.	25,000	23	13 12-in., 16 5.9-in.	Spezia	Laid down Mar. 24, 1912
Duilio.....	25,000	23	same	Castellamare	" " Apr. 30, 1912
Dandolo.....	28,000	25	10 14.2-in.	....	Projected
Morosini.....	28,000	25	same	....	"

BATTLESHIP "DANTE ALIGHIERI."—She was built at the Royal dockyard, Castellamare, having been laid down June 6, 1909, and launched August 8, 1910. The machinery, consisting of Parsons' turbines and Blechynden boilers, was built by Gio. Ansaldo, Armstrong & Co., Sampierdarena. Designed for a speed of 23 knots on 28,605 shaft horse-power, she developed 24 knots on 34,700 shaft horse-power, using forced draft and oil mixed with coal. The *Dante Alighieri* is of 21,000 tons displacement, 510 feet long on water-line, 85.3 feet beam and 28.5 feet mean draft. She mounts twelve 12-inch 46-caliber guns in threes in four turrets on center-line, the middle pair of turrets having no end-on fire; besides twenty 4.7-inch 50-caliber guns, eight in pairs in turrets and twelve in battery; sixteen 3-inch guns and three 18-inch submerged torpedo-tubes. The armor protection consists of a complete belt 9.8 inches thick amidships, tapering to 5.9 inches forward and 4.7 inches aft; 8.7 inches on sides of main deck amidships,

9.4 inches on turrets, 9.1 inches on barbettes and 3.9 inches on secondary turrets and battery. The forward conning-tower has 12-inch armor, the after one 7.9-inch armor and the deck sloping 2-inch armor.—*Shipping*, Illustrated.

During the week of September 11, 1912, the commissioning of the Italian battleship *Dante Alighieri* has been reported, 39 months from the date of laying down. So far as rapidity of construction goes, this is not a particularly good performance. There are many features about the Italian ship which call for comment. She is, of course, the first *Dreadnought*—properly so-called—to be completed for a Mediterranean power, though the French *Dantons* are generally regarded as *Dreadnought* equivalents. Again, the *Dante* is the first completed ship to be equipped on the triple-turret system, an idea which has since been adopted in the Austrian, Russian and United States fleets. No detailed reports of the gun trials of the Italian



ITALIAN BATTLESHIP "DANTE ALIGHIERI."

ship have been made public, but it is said that she came through them very successfully, and that the firing of the wing guns gave rise to no such turning movement in the turret as was in some quarters anticipated. Neither was there any reduction in the rapidity of fire. The speed performances of the ship, too, were noteworthy, for, although she was reported twelve months ago by *The Revista Nautica* to displace some 1200 tons more than the designed tonnage, the designed speed of 23 knots was exceeded on trial by a full knot, and that without pushing the turbines to their fullest power.—*Naval and Military Record.*

If the speed on her trials was, as is reported reliably, 24.5 knots, then the Italians have the fastest battleship afloat, and this is claimed by them.

Additional information concerning the trials of the *Dante Alighieri* states that on July 16 and 17 she maintained 21 knots for a period of 18 hours with fires in all of her 23 boilers and developed 21,000 horse-power instead of the contract requirement of 16,500 horse-power. The coal consumption was 700 grams per hour per horse-power, that is 200 grams less than stipulated. This 18-hour trial was immediately followed by a 6-hour forced-draft trial during which all auxiliary engines, including those for working the guns, were in operation. The maximum efficiency was a speed of 24.5

knots maximum and about 35,000 indicated horse-power. The engines were manipulated under varying conditions, and the backing turbines developed 14,000 horse-power. They also established in another run that the additional oil firing increased the horse-power from 16,000 to 25,000.—*Marine Rundschau.*

The *Cavour*, *Guilio Cesare* and *Leonardo da Vinci*, each of 22,000 tons displacement, have heavier armor than the *Dante Alighieri*, but lighter than the French and Austrian ships mentioned. These three ships will have the same speed as the *Dante Alighieri* and will be completed in September, 1913. The *Duilio* and *Doria* will be of an improved *Cavour* type and will be completed after a period of two years in building during the summer of 1914. They will have heavier armor and armament. Instead of 20 of 12-centimeter guns, they will carry sixteen 6-inch guns. The main battery of thirteen 12-inch guns will be mounted as in the *Cavour* class. They will also have fourteen 3-inch guns. Their length is 577 feet, beam 92 feet, draft 28 feet. Equipped with Parsons' turbines of 24,000 horse-power.

The Italian battleships *Dandolo* and *Morosini*, of the 1912-13 program, will be patterned after the American *Nevada* and *Oklahoma* class. They will mount ten 14-inch guns in four turrets, all in axial line, two of these mounting three guns each. The displacement will be 28,000 tons, speed 25 knots, and the secondary battery will consist of 6-inch guns. The indicated horse-power will be 49,000. The water-line armor belt will be complete, with a maximum thickness of 16 inches and will come up to the upper deck amidships. Moreover, the secondary or anti-torpedo battery, left unprotected on the *Nevada*, will be protected with 8-inch armor in the Italian ships. They will have no funnels and use liquid fuel. The new Italian gun for the *Dandolo* is reported as of being a 15-inch with a low initial velocity, firing a shell weighing 1653.5 pounds, and carrying 88 pounds of high explosive.

CRUISERS.—The protected cruiser *Marsala* will be completed in December, 1912, and the *Nino Bixio* in March, 1913. The sister ship *Quarto*, that is somewhat smaller, will join the fleet in commission in September, 1912.

The turbine cruiser *Quarto* made her trials satisfactorily. With 24-hour trial she made an average of 22.5 knots with 12,000 horse-power. The results of a 4-hour forced-draft trial were not published, the contract calls for 29 knots and 25,000 horse-power.

Two protected cruisers *Campania* and *Basilica* are being built at Castellamare for colonial service in the Red Sea to be completed by the end of 1914. These will be of 2600 tons displacement, 16.5 knots speed with great steaming radius. They will carry six 6.6-inch guns.

TORPEDO-BOATS.—There are 40 coast torpedo-boats building in private shipyards in Italy, 18 at Pattersons' works, Naples, 12 by Odero and 8 by Ansaldo at Genoa, all of which will use oil fuel and two are motor boats. Of these 13 are now in service. On their trials they made from 32 to 34 knots speed instead of the contract speed of 27 knots.

There are 10 destroyers building, 6 of the *Impavido* type and 4 of *Ardente* type. They have 700 tons displacement and carry one 5-inch and four 3-inch guns. The 6 destroyers of the *Impavido* type are fitted with the Tosi turbines. The *Indomito* made a speed of 36.1 knots on August 1 with forced draft, developing 17,000 horse-power, though only 30 knots were required by contract. The *Indomito* was built by the Societá Pattison, Naples, and she is the first of six Tosi turbine-driven destroyers which have been ordered from the Pattison Company for the Italian Navy. Her principal dimensions are the following: Length, 73 meters (239 feet 6 inches); breadth, 7.32 meters (24 feet); depth, 4.82 meters (15 feet 10 inches). There are two Tosi steam turbines, mounted in two separate

compartments, each driving a propeller. They develop together 15,000 shaft horse-power, and are designed to give the destroyer a speed of 30 knots. Five of these destroyers will be completed by the end of 1912, and the other five early in 1913. Italy then has 20 newer destroyers of from 400 to 700 tons and besides 43 efficient large torpedo-boats.

The torpedo-boat matériel has suffered considerably during the war and the supplementary appropriation of 15 million lire will be partly used to provide destroyers of over 900 tons displacement with oil fuel and 32 knots speed.

TORPEDOES.—The vessels now under construction will be armed with the 45-centimeter torpedo having a range of 4000 meters. Those succeeding will have the 53-centimeter torpedoes, the development of which is well advanced.

SUBMARINES.—Five of the eight submarines of the *Fiat* type, *Medusa, Beleda, Salpa, Argo,* and *Fisalia* are now in service. They made 14 knots surface speed on their trials. Two more of these will be completed in the spring of 1913. The *Nautilus* and *Nereide,* of 300 tons *Bernardi* type, will be completed by the end of 1912. The *G. Ferraris* and *G. Pullino,* 400-ton boats of *Cavallini* type, will be completed during the summer of 1913. The *Atropo,* 300 tons, *Germania* type, was delivered in September, 1912. This vessel, described on page 1137 of No. 143 of the PROCEEDINGS, has completed her first trials in the Bay of Eckernförde. The maximum speed was 14.7 knots, though the contract called for only 12. This was the mean of two runs over the measured mile. The Diesel motors are two cycle. By the middle of 1913, Italy will have 20 submarines. It is now proposed to build submarines of 500 tons displacement.

SUBMERSION TEST OF SUBMARINE.—The submarine *Squalo* was subjected to submersion test in Venice, July 29, and was submerged for 24 hours with her crew of 24 men without causing any injury to the health of the crew. This submerged endurance test was similar to that of the *Glauco* on June 14.—*Marine Rundschau.*

SUBMARINE SALVAGE VESSEL.—The Vulcan works, Germany, are building a submarine docking and wrecking ship that will be delivered in the summer of 1913.

NOTES ON NEW PROGRAM.—In view of the French shipbuiilding program Italy and Austria will be obliged to enlarge their shipbuilding program, especially since the annexation of Tripoli and Cyrenaica by Italy.

The new shipbuilding program does not provide for any battleship or battle-cruiser, but only protected cruisers of from 6500 to 700 tons displacement. These will have 6-inch guns, and vertical armor only in certain places with a heavily armored protective deck.—*Marine Rundschau.*

ANTI-AIR CRAFT PRACTICE.—The Italians conducted a series of 10 days target practice, firing against captive dirigible balloons which were towed along the coast by a torpedo-boat with lines of from 500 to 800 meters long at a distance of from 2 to 5 kilometers from the coast. They fired about 500 shells and shrapnel with tracer fuzes. In one case a balloon still floated in the air with two hits. The last practice was held in the presence of the Minister of War and Minister of Marine, two balloons of a volume of 15 to 25 cubic meters were destroyed by shellfire. One was hit at a range of 5000 meters. The guns used in this practice were mounted to permit an elevation of 75 degrees.—*Marine Rundschau.*

NAVAL ACADEMY.—In a competitive examination of candidates for naval cadets there were 400 candidates between the ages of 12 and 15 years, of

whom 284 were found physically qualified and 223 out of 227 passed the mental examinations, of these the first 50 were accepted and entered the Naval Academy.—*Marine Rundschau.*

OFFICERS RESTRICTED AS TO MARRIAGE.—An order issued by the Italian Navy Department on June 16, 1912, stating that all naval and army officers must have the consent of the King to marry, and that they must be over 25 years of age.—*Marine Rundschau.*

NAVIGATIONAL LAW.—The new Italian law requires all coal for the Italian Navy and Italian railroads to be imported from Wales in Italian ships. It is estimated that 700,000 tons will be required annually. The ships must carry 5000 to 6000 tons exclusive of their own bunker coal, for which they will receive a subvention of $60,000. The freight is fixed at $1.55 per ton for the first five years. The coal shall be imported from Cardiff, Barry Penarth, Talbot and Newport, and shall be delivered in 14 different Italian ports. This law is to continue in force for a period of ten years.—*Marine Rundschau.*

JAPAN.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Fuso	30,000	22	12 15-in., (?)	Kure	Laid down March, 1912
Battle-Cruisers					
Kongo	27,500	27	8 14-in., 16 6-in.	Vickers	Launched May 18, 1912
Hiyei	27,500	27	same	Yokosuka	" Nov. 21, 1912
Haruna	27,500	27	same	Kobe	Keel laid Mar. 16, 1912
Kirishima	27,500	27	same	Nagasaki	" " Mar. 17, 1912
Protected Cruisers					
Yahagi	5,000	26	6 6-in., 8 3-in.	Nagasaki	Delivered July 27, 1912
Hirado	5,000	26	same	Kobe	Commissioned June 17, '12

THE "SETTSU."—This vessel had her gun trials in Bungo Straits May 15. The official speed trials were also satisfactory, during these the *Settsu* made a maximum speed of 21 knots, while the prescribed speed was fixed at 20 knots. The ship was placed in commission on the same date, but placed in reserve to join the active fleet December 1, 1912.

"KAWACHI."—In the concluding paragraph of the article in the September issue, page 1141, on the Japanese battleship *Kawachi*, it was stated that the *Kawachi* was driven by Curtis turbines on three shafts, and the *Settsu* by Parsons' turbines on four shafts. Both these vessels, however, later advices state, are driven by Curtis turbines on two shafts.

DESTROYER.—The Japanese destroyer *Umikase* of 1150 tons has attained a speed of 33.46 knots on trial and is reported to be a very good sea boat. She is a good-looking vessel, and with her four funnels and semi-British appearance rather resembles the destroyers of the *Nubian* class. The trials of the sister ship *Yamakase* have also given satisfaction.—*The Engineer.*

MINE-LAYING VESSEL.—The Marine Minister has commenced to build a large mine-laying ship, *Sokuten Maru*, at the government yard in Maizuru which shall be completed early in 1914. This vessel is designed for service in the Pescadores Islands.

DRY DOCK.—The Sasebo dry dock is 777 feet long, 111 feet wide at bottom, with a depth of 38 feet over the keel blocks.

GUNS.—The guns for the *Kirishima* are being constructed by the Muroran Steel Works, in the Hokkaido, Northern Japan.

PROPOSED BUDGET.—The budget of 1913 is to contain thirteen large units, of which two are to be laid down in each year. Seven are to be super-*Dreadnoughts* of the largest type, mounted with 14-inch guns, and six will be powerful cruisers. Of these *Dreadnoughts*, five are to be built in the government dockyards of Kure and Yokosuka, whereas the other two are to be placed with foreign shipbuilders. The construction of the cruisers is to be effected in the private and government shipyards of Japan.—*The Marine Engineer and Naval Architect.*

The Japanese press published another argument by Paymaster Katagari for decreasing the personnel of the Japanese Navy. The number of the personnel is much greater than warranted by the tonnage and should be reduced. The naval budget of Japan is 35 per cent of all the government expenses and imposes a burden on the Japanese taxpayers twenty times greater than that proportionately borne in England.

MANEUVERS.—The Imperial Navy maneuvers were to begin on October 14 and to last up to November 10, terminating with a strategic exercise covering five days. Not less than 230 vessels were to take part. Admiral Dewa commands the Green fleet, representing the enemy, and Vice-Admiral Yoshimatsu the Red fleet, being the defending force.

FIRE ON THE "MIKASA."—K. Noguchi, a Japanese bluejacket with a grudge against the officers of the Japanese battleship *Mikasa*, Admiral Togo's flagship in the Russo-Japanese War, attempted to explode the magazine of the warship when she was lying at Kobe in October. He secured some gunpowder and combustibles and went into the ante-room of the magazine where the powder for the 12-inch guns was kept, with intent to start a fire and explosion, thereby committing suicide and involve the loss of the warship and many of the crew. Noguchi had fired his gunpowder in the ante-room and was lying dead as a result of the shock when four bluejackets ran in to find a heap of inflammable material burning, the fire working quickly toward the magazine. They hurriedly extinguished the blaze, and Noguchi's partly charred body was removed.—*Shipping*, Illustrated.

THE "NANIWA."—The Japanese attempts to re-float the *Naniwa*, which was wrecked some time ago, appear to have been abandoned. As the old cruiser was practically on the condemned list it is likely enough that the main reason the Japanese desired to salve her was a sentimental one. The *Naniwa* was the present Admiral Togo's ship at the time of the Chino-Japanese War. She fired the first shot in that war and this shot may be said to have been the foundation of the modern Japanese Navy.—*Engineer.*

NORWAY.

A new naval law was submitted to the Storthing in July providing $5,600,000 for the navy coast defence; $4,200,000 of this is estimated for building two coast-defence ships for defence of the coast at Bergen; $336,000 is estimated for building one submarine; $280,000 for torpedoes, and $168,000 for ammunition.

There is allotted for the defences and naval stations at Ofoten Fiord $252,000, at Christian Fiord (Horten cutoff) $196,000, at Bergen $112,000, at Christiansand $28,000 and Drontheim $28,000. In the discussion it was stated that the present defences had become obsolete and it was necessary to provide new defences so that the estimates could only be regarded as the first installments for the new defences that must be erected.

The Minister declared that in case of war between any of the great powers it would be obligatory to preserve the neutrality and prevent any violations of neutrality in the ports of Norway.* The defences at Christian Fiord were essential, especially to protect the Horten cutoff which was the available means of refuge for the Norwegian coast defence ships.

The desired naval shipbuilding program to extend over a period of years was not approved by the Storthing because they did not feel warranted to obligate future Storthing to the expenditures of a naval program.

Norway, now actively engaged in the reorganization of its long neglected fleet, has just placed an order with the Germania Krupp works at Kiel for the construction of a new submersible. This vessel will be delivered in 20 months and is an advance on anything now building. Three others are also under construction.

The last Storthing voted 20 million crowns for the modernizing of the fleet and coast defence. This sum will be used in the construction of two armored cruisers, fortifications near Narurk, and in the Christiania Fiord, and the building of naval bases at Bergen, Drontheim and Christiansand. Outside the above sum other credits will be voted for the national defence. According to the naval program the fleet will be increased by six new armored cruisers, six destroyers, about 40 torpedo-boats and 14 submersibles.—*Revue Internationale.*

PERU.

The armored cruiser *Commandante Aguirre,* formerly the French *Dupuy de Lôme,* sailed from the Lorient for Peru on October 15.

Dupuy de Lôme was a famous French naval constructor, who, in 1860, completed, in pursuance of an order of Napoleon III in 1858, the *Gloire,* the first iron-armored frigate to be built.

RUSSIA.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Sevastopol	23,300	23	12 12-in., 16 4.7-in.	Baltic Works	Launched June 29, 1911
Petropavlovsk.	23,300	23	same	" "	" Sept. 9, 1911
Poltava	23,300	23	same	New Admiralty	" July 10, 1911
Gangut	23,300	23	same	" "	" Oct. 7, 1911
Emperor Alexander III	22,860	21	12 12-in., 20 4.7-in.	Ivan Bunge Co.	Building
Empress Marie	22,860	21	same	" " "	"
Catherine II...	22,860	21	same	Nikolaieff	"

SHIPBUILDING.—The large units of the program voted by the Duma have been ordered from the Baltic and Admiralty dockyards. Besides four cruisers of 6500 tons to be built in three years have been ordered. The program includes 36 torpedo vessels which ought to be ready by 1916, 12 being laid down each year.

*In this connection the article by Commander Hovgaard in PROCEEDINGS No. 137 will be found of interest.

Two cruisers of 3500 tons for artificers' schoolships will be built outside Russia.

The four armored cruisers which form part of the year's program will have a displacement of 30,000 tons, and will be built in shipyards at St. Petersburg, two at Galernis Island, and two at the Baltic yard. They will carry 14-inch guns, and will be laid down in spring of 1913.

The Duma adopted the small-ship building program. This is the first definite shipbuilding program modeled after the German practice that has been adopted by Russia. The advantages of a definite shipbuilding policy is thus becoming universally recognized as necessary.

The small-ship building program calls for a total of $258,000,000 (approximately) to be expended in the period from 1913 to 1917, with annual installments that must be appropriated each year by the Duma as follows: 1913, $58,000,000; 1914, $52,500,000; 1915, $52,500,000; 1916, $52,500,000; and 1917, $42,500,000.

(1) For the fleet there are $200,000,000 to provide, viz.: Four armored cruisers; eight small cruisers, four for the Baltic and two each for the Black Sea and Siberian fleets; 36 high-sea torpedo-boats; 18 submarines, 12 for the Baltic, and six for Siberian fleets; (2) $7,900,000 to provide for auxiliary ships; (3) $5,500,000 for floating harbor works; (4) $5,800,000 for Baltic works and Oubuchow yard; (5) $36,000,000 for harbor works at Reval, Cronstadt, Sveaborg, Sebastopol, Nickolajew and Vladivostock.

MILITARY PORT.—The Czar laid the corner-stone of the military port of Reval on July 12, 1912. This port is to be the advanced Russian naval base in the Baltic. The Czar designated the naval base as that of Peter the Great. It is estimated to require ten years to complete this.

THE "NOVIK."—The Russian destroyer *Novik* made 36.25 knots on her official trials last month. The vessel, which is 336 feet long by 31 feet 6 inches beam, is of 1280 tons displacement, and was built at St. Petersburg, the machinery consisting of A. E. G. turbines and oil-fired boilers, being supplied by the Vulcan Company, of Stettin. The designed speed was 35 knots with 36,000 shaft horse-power, but both have been considerably exceeded.

AVIATION.—An aviation station has been established at St. Petersburg where the navy has received two Curtiss hydroaeroplanes having a speed of 50 miles per hour, and a third Curtiss hydroaeroplane is expected having a speed of 54 miles per hour.

TURKEY.

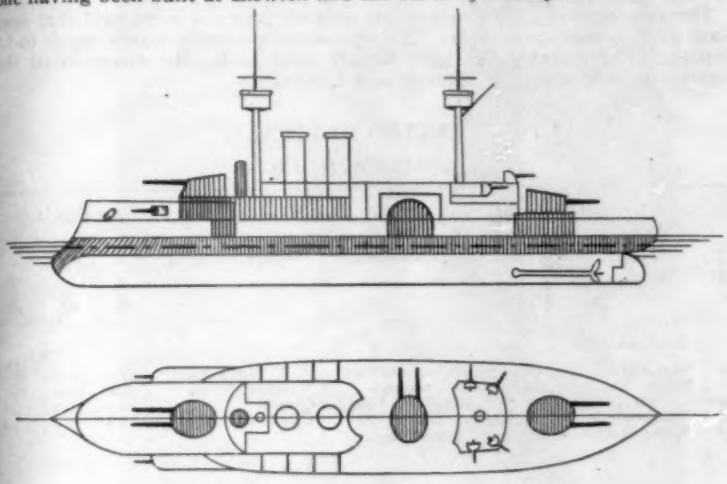
VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
*Reshad-I-Hamis	23,000	21	10 13.5-in., 16 6-in.	Barrow	Building
*Reshad V	23,000	21	same	Elswick	"

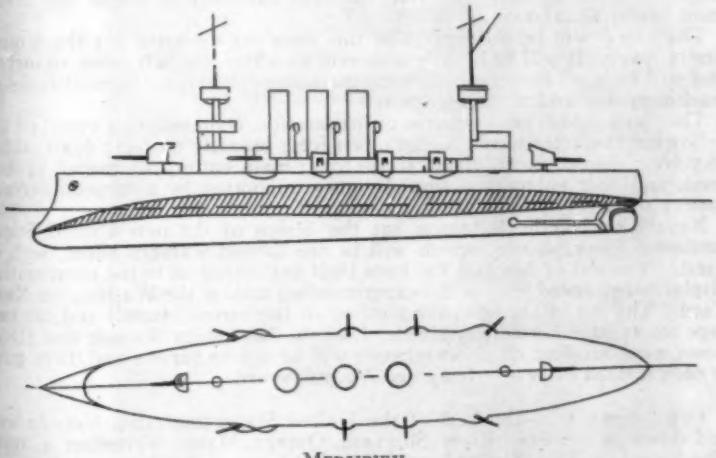
* Work on these vessels has been stopped and they have been advertised for sale. These vessels are 525 feet long, 27½ feet draft, horse-power of 31,000 tons, main armor belt 12 inches thick. They are quite well advanced in construction.

The two largest Turkish battleships are the *Kheije-ed-din Barbarossa* and the *Torgut Reis*, vessels of 9900 tons displacement and purchased from the German Government. These are well protected, carry six 11-inch, mounted in three turrets, eight 4-inch and eight 3.4-inch rapid-fire guns, and have a speed of 17 knots.

The *Messondiych*, built on the Thames in 1874 and reconstructed at Genoa in 1902, has a displacement of 9000 tons, and carries two 9.2-inch and twelve 6-inch guns, with a speed of 17.5 knots.* The cruisers *Hamidich* and *Medjidieh* are excellent modern cruisers of 4000 tons with speed of 22 knots, one having been built at Elswick and the other by Cramps.



HAIRREDIN BARBAROSSE AND TORGUD REIS



MEDJIDIEH.

Besides these there are two, the *Assar-I-Tewfik* and the *Muin-i-Zaffer*, the former of 5600 tons, the latter of 2400 tons, both old vessels.

*The battleship *Feth-i-Bulend*, reported on November 3 as having been sunk by a Greek destroyer, was a single screw vessel of 2800 tons, built at Blackwall in 1870 and reconstructed at Genoa in 1907. Armament was of four 5.9-inch and six 2.9-inch guns.

On page 727 of the June issue will be found a complete list of the Turkish Navy at the commencement of the Italian-Turkish War.

Their armament is two 9.2-inch, twelve 6-inch, and fourteen 3-inch guns.

There are twelve large destroyers and twelve modern torpedo-boats, besides many gunboats.

The personnel of 31,000 men exists only on paper, it being said that one-sixth only is really available. The equipment generally leaves much to be desired. The training has been largely done under the direction of the English retired admirals, Gamble and Limpus.

UNITED STATES.

VESSELS BUILDING.

Number	Name	Displacement	Speed	Armament	Where Building	% of Completion		
						Sept. 1	Oct. 1	Nov. 1
	Battleships							
34	New York....	27,000	21	10 14-in., 16 5-in.	N. Y. Navy Yard	47.5	52.8	58
35	Texas.....	27,000	21	same	Newport News	71.6	73.9	76.7
36	Nevada.....	27,500	20.5	10 14-in., 18 5-in.	Quincy	1.2	1.3	1.6
37	Oklahoma....	27,500	20.5	same	Camden	1.3	2.0	3.3
38	Pennsylvania	31,000	23	12 14-in.				

THE "PENNSYLVANIA."—The new battleship *Pennsylvania*, authorized by act of Congress, August 22, 1912, is to cost, exclusive of armor and armament, about $7,425,000.

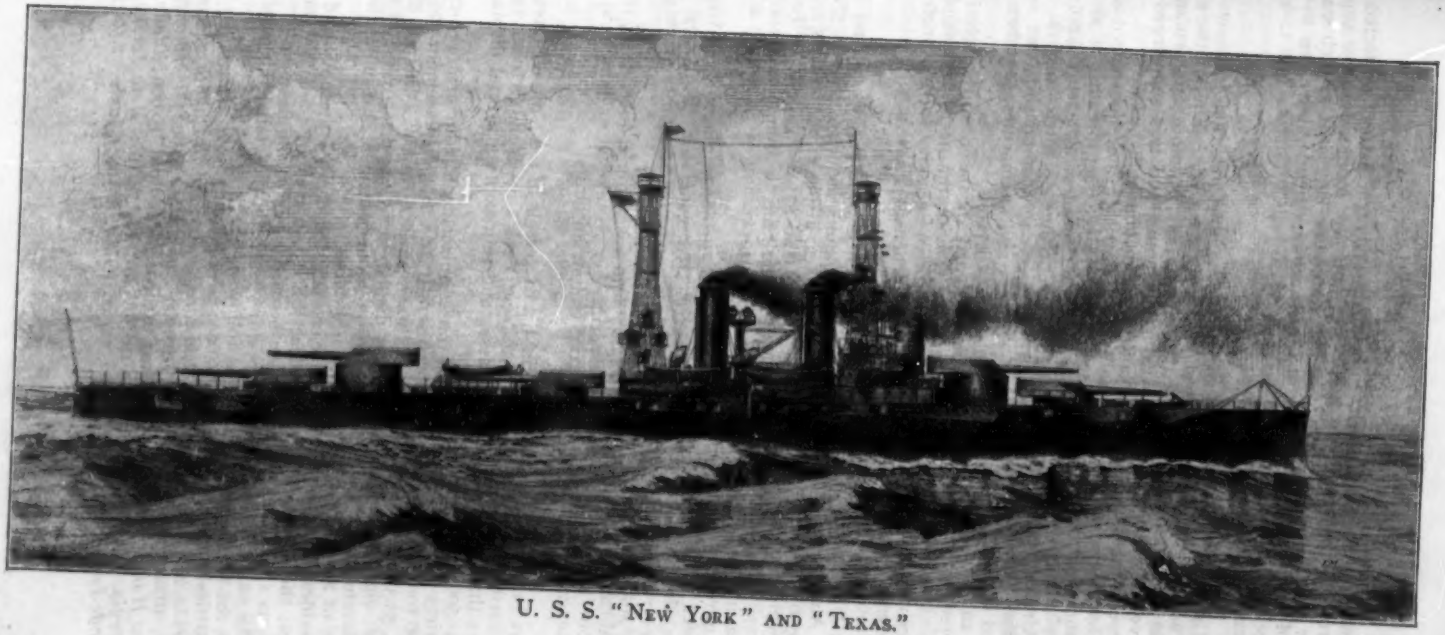
The vessel will be the largest of this class yet designed for the United States Navy. It will be heavily armored, its water-line belt being 16 inches, and will have oil-burning boilers of the water-tube type. Several types of machinery are under consideration.

The plans, which are in course of preparation, contemplate a vessel of the following characteristics: Length, 600 feet; breadth, 97 feet; draft, about 28.5 feet; displacement, about 31,000 tons; main battery of twelve 14-inch guns, and four submerged torpedo-tubes, supported by a torpedo-defence battery of twenty-two 5-inch guns.—*The Navy.*

Naval Constructor Robinson has the design of the new United States battleship *Pennsylvania*, which will be the largest warship afloat, well in hand. A model of her hull has been built and tested as to the comparative displacement, speed, etc., in the experimenting tank at the Washington Navy Yard. The cut of the bow, the position of the turrets, funnel and the two cage masts have been determined. Like the battleships *Nevada* and *Oklahoma*, now building, the *Pennsylvania* will have four turrets and three guns in each instead of two.—*Army and Navy Journal.*

THE "NEVADA."—The keel of the United States battleship *Nevada* was laid down in the Fore River Shipyard, Quincy, Mass., November 4, 1912. The *Nevada* will be 583 feet long and 95 feet beam, and will have a displacement of 27,600 tons. She will carry ten 14-inch guns in four turrets, besides a secondary battery. Her contract calls for delivery in January, 1915.—*Army and Navy Journal.*

THE "NEW YORK."—This vessel was successfully launched at the New York Navy Yard on October 30. Her principal dimensions are: Length, 573 feet; beam, 95¼ feet; draft, 28½ feet; displacement, 27,000 tons; speed, 21 knots; armament, ten 14-inch guns; twenty-one 5-inch guns, 19 of which



U. S. S. "NEW YORK" AND "TEXAS."

are mounted on the main deck, 10 being in a central battery protected by 6-inch armor. The remaining two 5-inch guns are mounted on the superstructure near the conning-tower. The water-line belt is of 12-inch maximum and is complete. A strake of 9-inch armor extends above this to the main deck. Transverse bulkheads are of 10-inch. Turrets are 12-inch. Reciprocating engines are to be installed.

THE GENERAL BOARD'S 1913 PROGRAM.—The 1913 program for new war vessels, as prepared by the General Board, calls for four ships of the same design as the *Pennsylvania*, with a speed of about 25 knots, and armament of twelve 14-inch guns, twenty-two 5-inch guns, and two submerged 21-inch torpedo-tubes. Oil-burning boilers are recommended.

Two battle-cruisers also will be asked for, with a minimum speed of 28 knots, and eight destroyers, having a length of 288 feet, breadth of 26 feet, and displacement of 742 tons, with a contract speed of at least 30 knots.

The United States Navy has at the present time no battle-cruisers. The auxiliaries asked for include two fuel ships, one hospital ship, one repair ship and one or two tenders for destroyers and submarines, together with supply and ammunition ships.

The recommendations of the General Board are based on the belief that a fleet of forty-eight first-class battleships, with the necessary supply of battle-cruisers and auxiliaries, is an imperative necessity for the protection and defence of this country and its dependencies.—*The Navy.*

THE "JUPITER."—This vessel was launched at the Mare Island Navy Yard, August 24. She will make about 14 knots an hour. She is 572 feet long by 65-foot beam; draws 27 feet 6 inches, displaces 19,360 tons and has a carrying capacity of 12,500 tons of coal and 375,000 gallons of fuel oil. The keel was laid October 16 last and the hull has been built in record time at a saving of nearly $100,000 over the appropriation of $1,200,000 allowed by Congress.

Power is supplied by a six-stage steam turbine engine of an American design, driving a 14,000 horse-power electric generator, the largest of its kind ever built. The current from this is conducted to motors driving twin-screw shafts.

Coal can be loaded from the *Jupiter* into a warship at the rate of 100 tons an hour and duplex pumps will permit her to take in or pump out oil to another vessel at the rate of 120,000 gallons an hour.

THE FLEET REVIEW.—The official list of vessels of the United States Navy, mobilized in the Hudson River at New York City from October 12 to 15, shows that 127 vessels of all classes and representing a total displacement of 741,500 tons took part.

Thirty-one battleships, 478,508 tons displacement; four armored cruisers, 58,000 tons displacement; four cruisers, 15,663 tons displacement; 20 special type, 55,373 tons displacement; six naval militia vessels, 4581 tons displacement; eight fuel ships, 88,385 tons displacement; 24 destroyers, 16,947 tons displacement; 16 torpedo-boats, 3029 tons displacement; 10 submarines; 123 ships of all classes, 720,486 tons displacement.

Besides the 1539 officers and 28,000 enlisted men of the navy and marine corps, there were about 108 officers and 950 men of the naval militia of various states filling vacancies on board vessels of the fleet.

The names of the several types of vessels that attended the mobilization, with the tonnage of each, are as follows:

Battleships.—*Connecticut*, 16,000; *Arkansas*, 26,000; *Wyoming*, 26,000; *Florida*, 21,825, *Utah*, 21,625; *Delaware*, 20,000; *North Dakota* 20,000; *Michigan*, 16,000; *South Carolina*, 16,000; *Louisiana*, 16,000; *Vermont*, 16,000; *New Hampshire*, 16,000; *Kansas*, 16,000; *Minnesota*, 16,000; *Idaho*, 13,000; *Georgia*, 14,948; *Virginia*, 14,948; *Nebraska*, 14,948; *New Jersey*, 14,948; *Rhode Island*, 14,948; *Missouri*, 12,500; *Ohio*, 12,500; *Maine*, 12,500; *Illinois*,

11,552; *Wisconsin*, 11,552; *Alabama*, 11,552; *Kearsarge*, 11,520; *Kentucky*, 11,520; *Iowa*, 11,346; *Indiana*, 10,288; and *Massachusetts*, 10,288; total displacement, 491,508 tons.

Armored cruisers.—*Washington*, 14,500; *Montana*, 14,500; *Tennessee*, 14,500; *North Carolina*, 14,500; total, 58,000 tons.

Cruisers.—*Salem*, 3750; *Birmingham*, 3750; *Chester*, 3750; and *Baltimore*, 4413; total, 15,663 tons.

Various types.—*Dolphin*, gunboat, 1486; *Nashville*, gunboat, 1371; *Petrel*, gunboat, 890; *Montgomery*, torpedo practice ship, 2072; *San Francisco*, mine-laying ship, 4083; *Mayflower*, converted yacht, 2690; *Yankton*, converted yacht, 975; *Dixie*, destroyer tender, 6114; *Castine*, submarine tender, 1177; *Severn*, submarine tender, 1175; *Tonopah*, submarine tender, 3225; *Prairie*, transport, 6620; *Celtic*, supply ship, 8000; *Culgoa*, supply ship, 6000; *Solace*, hospital ship, 5700; *Panther*, repair ship, 3380; *Lebanon*, ammunition ship, 3285; fleet tugs *Sonoma*, 1120; *Ontario*, 1120; *Patapsco*, 755; *Patuxent*, 755; *Machias*, gunboat, 1177; *Marietta*, gunboat, 990; converted yacht *Vixen*, 806; *Gloucester*, 786; *Wasp*, 630; and *Aileen*, 192; total, 66,584 tons displacement.

Destroyers.—*Smith*, *Lamson*, *Flusser*, *Preston*, and *Reid*, each 700; *Paulding*, *Drayton*, *Roe*, *Terry*, *McCall*, *Perkins*, *Sterett*, *Walke*, *Ammen*, *Burrows*, *Monaghan*, *Patterson*, *Trippe*, *Fanning*, *Jouett*, *Beale*, and *Jenkins*, each 742; *Worden*, 433; and *Macdonough*, 400; total, 18,431 tons.

Torpedo-boats.—*Tingey*, 165; *Craven*, 146; *Shubrick*, 200; *Thornton*, 200; *DeLong*, 196; *Stockton*, 200; *Dahlgren*, 146; *Bailey*, 280; *Bagley*, 175; *Barney*, 175; *Biddle*, 175; *Stringham*, 340; *Porter*, 165; *Blakely*, 196; *Dupont*, 165; and *Morris*, 103; total, 3029 tons.

Submarines.—*C 1*, *C 2*, *C 3*, *C 4*, *C 5*, *D 1*, *D 2*, *D 3*, *E 1*, *and E 2*.

Fuel ships.—*Orion*, 19,132; *Cyclops*, 19,360; *Sterling*, 5663; *Vulcan*, 11,230; *Hector*, 11,230; *Cæsar*, 5920; *Brutus*, 6600; and *Ajax*, 9250; total, 88,385 tons.

ACCIDENT ON THE "WALKE."—On October 1, 1912, while preparing for her second quarterly speed trials, the port turbine casing blew up, killing Lieutenant D. P. Morrison and four men. This is an unprecedented accident in the engineering experience of the service. The *Walke* is a destroyer of 742 tons and was built at the Fore River Shipbuilding Company at Quincy, Mass. The propelling machinery consists of two sets of Curtis turbines of 12,573 horse-power. The cause of the accident as determined by the court of inquiry has not been made public.

ORDNANCE AND GUNNERY.

GUNS AND PROJECTILES.

THREE-GUN TURRETS.—Three-gun turrets are not in favor in Germany. Recently a three-gun turret for 12-inch guns was built, and the trials, kept secret, were far from successful. It is said that the three guns could not fire as many shots as two guns in an ordinary turret. Moreover, the confusion among the gunners was extreme, resulting in a very slow rate of fire. To obviate this, the men were carefully drilled without obtaining much better results. Therefore, the commission studying this type of turret has pronounced against it.—*Le Yacht*.

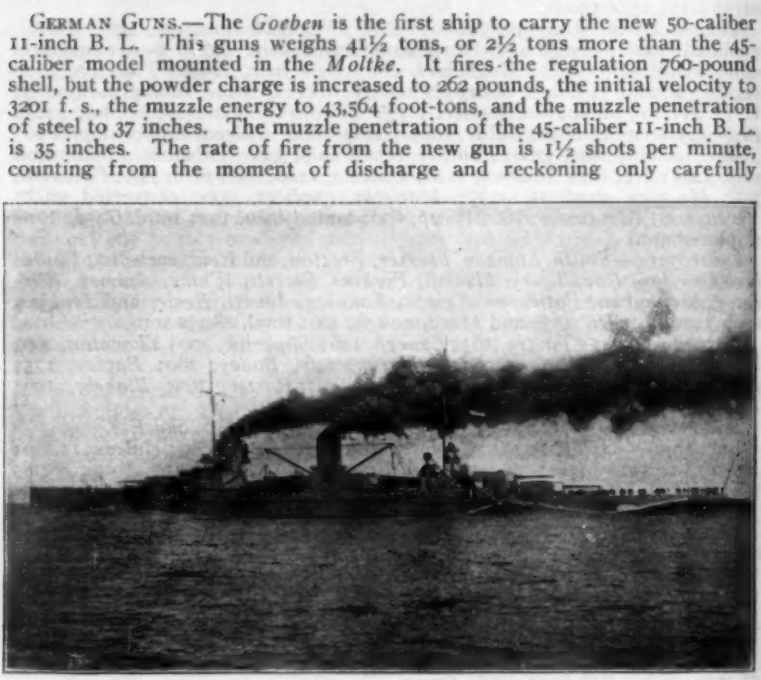
The Chief of the Bureau of Ordnance announces that the three-gun turret for the new battleship *Nevada* has stood a satisfactory test at Indian Head. As the development of this new style of turret involves some very intricate problems which the Ordnance Bureau has solved, the Navy Department naturally is determined to keep the details secret until the work of installing the new turrets has actually been started.

The Austrian battleship *Viribus Unitis* and the Italian battleship *Dante Alighieri* both have been recently commissioned, and illustrations showing

the triple turrets are produced elsewhere in this issue of the PROCEEDINGS. It is known that the Austrian mount has all three guns working in a single sleeve elevating and training all at the same time.

FOUR-GUN TURRETS.—Although the French had completed a design for these, late advices indicate that they will not be installed.

GERMAN GUNS.—The *Goeben* is the first ship to carry the new 50-caliber 11-inch B. L. This guns weighs 41½ tons, or 2½ tons more than the 45-caliber model mounted in the *Moltke*. It fires the regulation 760-pound shell, but the powder charge is increased to 262 pounds, the initial velocity to 3201 f. s., the muzzle energy to 43,564 foot-tons, and the muzzle penetration of steel to 37 inches. The muzzle penetration of the 45-caliber 11-inch B. L. is 35 inches. The rate of fire from the new gun is 1½ shots per minute, counting from the moment of discharge and reckoning only carefully



GERMAN CRUISER OF THE LINE GOEBEN.

aimed shots from a moving ship. The entire powder charge is in a brass case, a method which, as experience has shown, does not tend to expedite loading. In the 45-caliber 11-inch B. L. the charge is in two sections, only the second being cased. There is reason to believe that the cartridge-case system for heavy gun charges will shortly be abolished in Germany, as there are complaints both as to the extra expense and weight involved. On the grounds of safety in storage and handling the brass envelope has some claim to recognition, but otherwise its utility is by no means so great as is popularly supposed. Germany and Austria are the only two powers which still adhere to this system for big guns.—*Naval and Military Record.*

NEW AUTOMATIC MILITARY RIFLE.—A new automatic self-loading infantry rifle, invented by Mr. Franklin K. Young, of Boston, has been examined by a board of ordnance experts of the army, who think so highly of it that Col. S. E. Blunt has approved a recommendation that the United States armory at Springfield be authorized to construct rifles on this model. The *Boston Globe*, describing this new rifle, says, in part:

"Its features are, briefly, that the barrel is set immovably into the frame, the bolt is locked into the rear of the barrel, the loading mechanism is

operated by the standard ammunition in use in the service, it is the only automatic rifle to have a single-shot action, it takes nothing from the perfections of the present military rifle, but adds the automatic firing feature.

"This automatic feature can be applied to sporting rifles, pistols, machine guns and light field guns for the artillery. Such a machine gun would weigh fifty-five pounds complete and would have a firing capacity of sixteen shots per second or 960 shots per minute. Applied to field guns, their weight would be reduced to two-fifths their present bulk, and guns using an eight-pound projectile would have a firing capacity of 120 shots per minute.

"The new rifle invented by Mr. Young possesses the qualities of automatic reloading, the ejecting of the old cartridge, and the breech bolt is securely locked until the bullet has left the bore. In case of misfire or jamming the chamber is more easily freed than in the present service rifle.

"The new weapon weighs only 10 pounds 2 ounces; its parts are interchangeable and readily replaced, and the present service rifle can be quickly and inexpensively converted into automatics of this model, it is claimed. The official report to Brig.-Gen. William Crozier, Chief of Ordnance, U. S. A., states that it will be 'serviceable, endurable and efficient.'

"The rifle is so constructed that each shot is controlled by the will of the user, or, in other words, it fires only one shot at the pull of the trigger, but the speed of operation is normally equal to that of the machine gun, the inventor claims.

"This rapidity of fire, while desirable, is by no means the chief value of the automatic rifle. Its chief advantage lies in the relief from fatigue afforded the soldier through his not having to operate the loading mechanism by hand.

"To illustrate this point it may be said that the infantry rifle of to-day requires four separate movements before the soldier is ready to sight and fire. The labor of loading increases as the bolt becomes heated and fouled. In other words, if the soldier fires 400 shots he makes 1600 movements of his hand, excluding the pulling of the trigger. With the new rifle Mr. Young has invented the 1600 movements are reduced to zero.

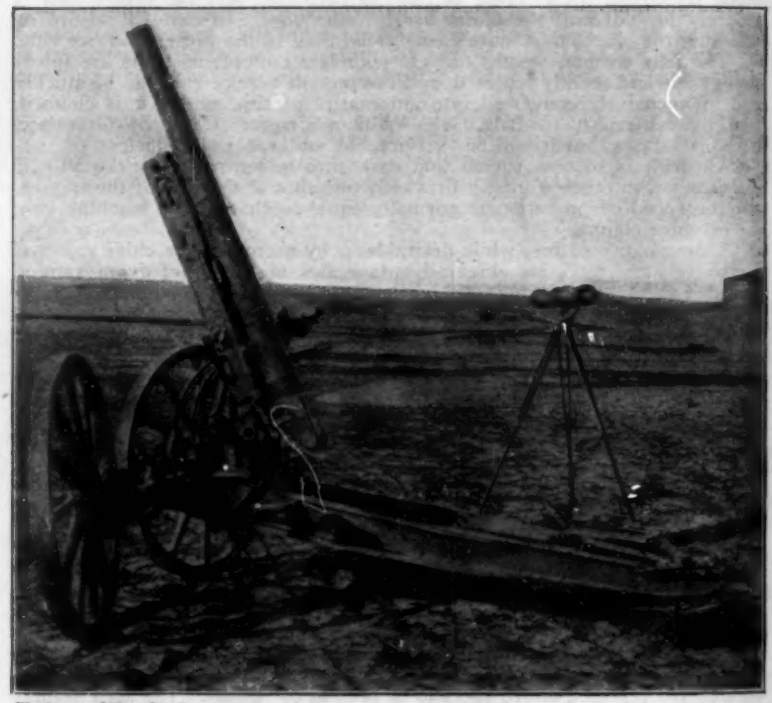
"By the use of the new rifle a soldier has always two shots available against one of his enemy's, and he can have a third shot by inserting a cartridge by a single movement. To fire three shots in return his enemy must make eight separate movements, supposing his rifle has a cartridge in the chamber to start with."—*Army and Navy Journal.*

ILLUMINATING SHRAPNEL.—The *Artilleristische Monatsheft* states that the Italians have successfully experimented with the Toccacielo illuminating shrapnel. This shrapnel was fired from a 6-inch gun at the naval proving grounds at Via Reggio, April 11, 1912. The target was anchored at sea and the exploding shrapnel illuminated the area around the target long enough for repeated aimed shots to be fired at the target. The area illiuminated was that of a circle of approximately 500 yards radius. The test proved not only the efficiency of the illumination, but that the position on shore at the gun was not revealed during the firing that night. The exact time in seconds that the area remained illuminated was not given.

EXPERIMENTS WITH DELAYED ACTION H. E. FUSES.—In the latter part of September off Cherbourg some interesting high-explosive shell and fuse trials took place against the old *Neptune*. Plates of armor similar to side armor of battleships were secured on board, and the firing was done from a shore battery. The new armor-piercing shell of 6.4-inch caliber fitted with a special fuse was fired at the plates from 450 yards distance. The shell penetrated the plate and detonated behind it. The gas and pieces would have produced great damage in the interior of a battleship. The battery also fired shell of 9.6-inch caliber. The latter detonated beyond the plate and sent pieces in all directions for five-eighths of a mile. Very little exact information is procurable. The French, however, seem convinced that they

have a perfect high-explosive fuse, and that the problem of bursting mélinite shells in the interior of armored and unarmored vessels at all battle ranges is solved. In these experiments various velocities were used so as to represent the battle ranges, the short range adopted for the tests being due to the desirability of hitting the steel at the point desired.

HADFIELD CAST-STEEL PROJECTILES.—The letting of a small part of the contract for shell to the Hadfield Foundry Company, of Sheffield, England, by the Navy Department is to determine the quality of this particular make of English projectile. Price is an important consideration, of course, but



The Army and Navy Gazette.

FIG. 1.—EHRHARDT GUN.

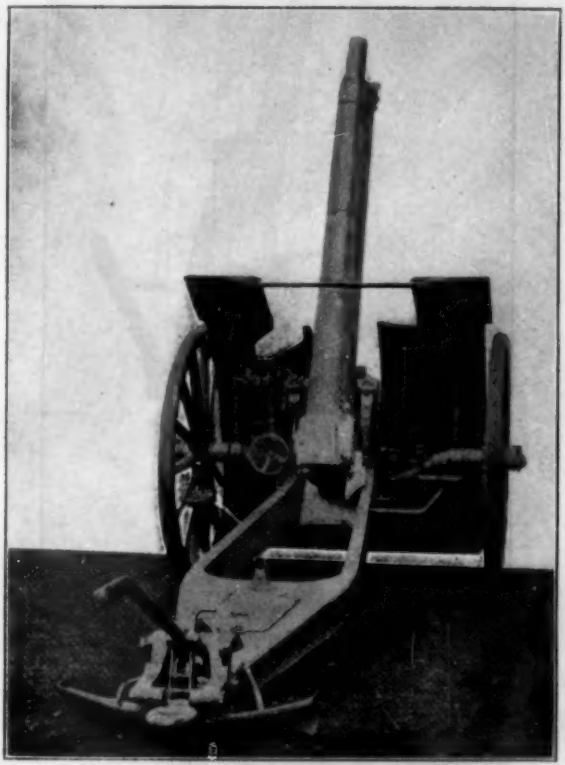
to sacrifice the effectiveness to save the difference between the cost of American and English shells would not only be an unwise, but a dangerous economy. The claim is made by the Hadfield concern that it has a superior and cheaper process of treating steel for projectiles. Already some small contracts for Hadfield projectiles have been filled in this country. This is arranged by paying a royalty to the English concern.—*Army and Navy Register.*

ENGLISH ANTI-AEROPLANE GUNS.—A gun firing a 31-pound shell and having a long height range, with an extreme elevation of 80 degrees, is to be furnished the new British warships.

ANTI-AIRCRAFT GUNS.—The gun invented by Ehrhardt of Düsseldorf is the most effective and practical one to date, and it has been finally adopted

by the German Government after careful experimentation. There are several models of this gun of various calibers from 1.96-inch to 4.13-inch. Figures 1 and 2 herewith show his gun of 2.95 inches in caliber mounted on a field carriage.

The greatest range of this gun is 10,661 yards or about 5¾ miles. The greatest elevation is 70 degrees, at which the projectile reaches the height of 7435 yards or nearly 4¼ miles, considerably higher than is the usually attained altitude of aircraft.



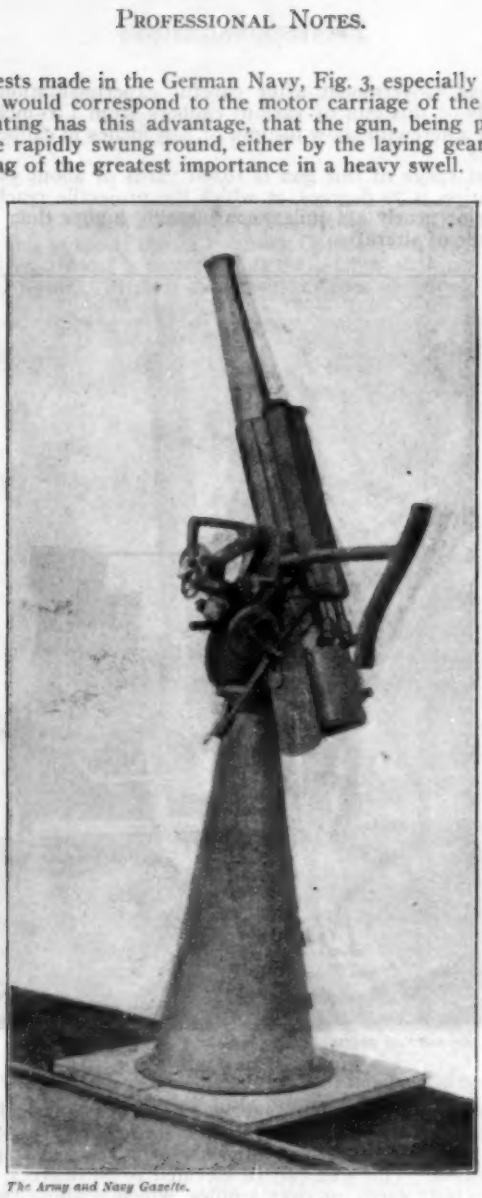
The Army and Navy Gazette.

FIG. 2.—EHRHARDT GUN.

A much more powerful weapon is Ehrhardt's 4.13-inch gun, whose longest range at an elevation of 43 degrees is 12,992 yards, or very nearly 7½ miles, its highest altitude of 4319 yards being reached at 4¼ miles from the firing position. This gun can be elevated to 70 degrees, when its projectile rises to 9077 yards, or over 5 miles, which is about twice the height hitherto attained by any airman. This gun, also, can be mounted on a field carriage.

The mounting of such guns on field carriages has this advantage that they can also be used as ordinary field guns; but as they would thus be drawn by horses, and consequently could not move so rapidly as aircraft, Ehrhardt has devised a special motor carriage. This anti-aircraft gun, on a cone-mounting, can be fitted to the deck of a war vessel of any kind, and was so

fitted in the tests made in the German Navy, Fig. 3, especially a destroyer—which at sea would correspond to the motor carriage of the gun on land. Such a mounting has this advantage, that the gun, being pivoted on its center, can be rapidly swung round, either by the laying gear, or by hand, the latter being of the greatest importance in a heavy swell.



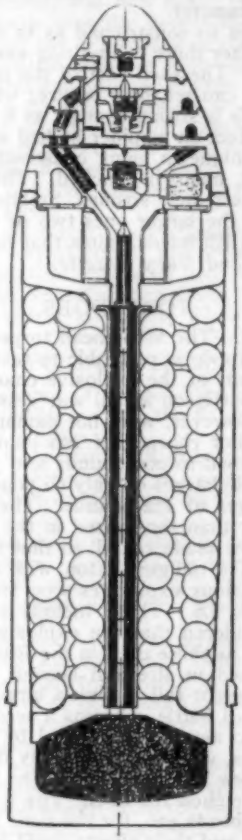
The Army and Navy Gazette.

FIG. 3.—EHRHARDT GUN.

Very ingenious is the sighting mechanism of the gun. Errors arising from drift, or difference of wheel level, can be quickly rectified. The range is ascertained either by judging the distance or, better still, by a modern range-finder, which has now been brought to such perfection as to make it possible to obtain the range with the greatest accuracy in the shortest possible time.

This found, the range is conveyed to the gun-layer, who adjusts the distance scale of the sighting mechanism accordingly, and has then nothing to do but to cover the aircraft with the telescope. The action of moving the spy-glass at the same time also adjusts with perfect accuracy the gun's aim.

But the air vessel moves rapidly, and the gun must be able to adapt itself thereto, or, in other words, the bursting point of the projectile must be rapidly changed. This is effected by an automatic fuse-setting key, which



EHRHARDT'S HIGH-EXPLOSIVE SHRAPNEL SHELL.

permits of slight alterations in the bursting time of the composition ring simply by thumb pressure.

The projectile used against aircraft is not a simple shrapnel, but is a combination of shell and shrapnel with corresponding double action.

It is a high-explosive shrapnel, of which Ehrhardt and Captain Van Essen are the inventors, and is admittedly the most perfect thing of its kind. The body of the projectile is shrapnel, while the head, or nose, carrying the second fuse and containing a high-explosive charge, follows the shell portion. The time fuse ignites the bursting charge in the base of

the shrapnel, which sets free the bullets and throws them forward with tremendous force.

The explosion of the bursting charge, however, detaches the shell-head from the shrapnel body, causing it to shoot forward, as a separate projectile, for some 130 yards, when its high explosive contents burst with a force strong enough to overturn a field gun and ammunition wagon.

The result of it all is that the exploded fragments and bullets of five of these shell-shrapnel projectiles—fired with Pom-pom like rapidity—bring certain destruction to anything within a tubular air space of 700 yards long and over 300 yards in diameter.

The double projectile is so constructed as to develop a cloud of smoke, to show the gunner whether there is anything amiss with his aim, which he can then rapidly correct. The shell part of the projectile is especially dangerous to dirigibles, as it can set them on fire; while, if the mere explosion of such a terrific projectile is strong enough, as it is, to overturn a field gun, what is likely to be its effect on a spider-bodied aeroplane?

Ehrhardt's guns are unique in being constructed from a solid block of the best procurable steel, mandril punched. This method compresses the material and renders it extremely strong. Smaller guns are made of single tubes, but in the case of the larger ones two or more tubes are employed, and by this same process Ehrhardt claims that he can make cannon of the heaviest caliber.—*Army and Navy Gazette.*

TORPEDOES.

AUTOMOBILE TORPEDOES.—The Whitehead torpedo is now almost the only one in the field. The torpedo is now able to take its place as the equal of the gun. The development of the explosive charge is the result of explosion experiments made partly on actual war vessels and partly on caissons of smaller size, which, however, were not damaged to the same degree as larger objects. The earlier charges of 200 pounds to 250 pounds of explosive material have grown to 260 pounds and 330 pounds. The original Whitehead torpedoes had charges of only 66 pounds, and those used in the Japanese War had charges of 132 pounds. The weight of the charges is now 150 per cent greater than those used in the last-mentioned war. The old pointed heads are now made round, so that the charges explode closer to the points of attack. The old gun cotton, with its specific gravity of 1.2 to 1.3, has given way to various explosives won from coal tar and having a specific gravity of about 1.6. These include picric acid, called lyddite, shimose, etc. It is considered that the explosive value of the charges is now three times as great as those used in the Russo-Japanese War. Meanwhile ships have increased in size and become relatively less vulnerable. One hit with a torpedo might fail to sink a large warship, but it will compel her to leave the line of battle, whereas a second hit will probably complete the work. Torpedo nets are now used by every country, except the United States of America, where it is probably thought that they would be of no avail against the new Davis weapon. The Bullivant net as fitted in a large English warship weighed 100 tons. The weights built into vessels in the form of division bulkheads, etc., for the same purpose were even greater. If necessary, the charges and their effects could be still further increased.

With regard to range, the 21-inch English torpedo, Mark II, is said to run for 10,000 to 11,000 yards, and it probably has an effective range of about 6560 yards, and the weapons of other nations would probably shortly do much the same. This range is sufficient, but practical trials must decide whether further improvements in the motor should be devoted to increase of the speed. The motor used was the Brotherhood compressed air engine. From the original 328 yards the range has been first increased to 875 yards, then gradually advanced to 2187 yards, and finally to 3828 yards, by improvements in the material and increase of the size of the air vessel accompanied by the adoption successively of the three-cylinder and four-cylinder engines. An apparatus is now inserted which heated the air before use. Attempts are now being made to replace the Brotherhood engine by a

turbine, and this or other motive machinery would probably further increase the performances already attained.

As regards steering, the maintenance of a desired depth below the surface is now satisfactorily accomplished. The uncertainty of aim due to imperfect knowledge of the speed of the enemy, can be reduced by increase of speed of the torpedo, but not avoided. The actual deviation from the course given by the direction of the tube is reduced to about 1 per cent of the distance travelled by the introduction of the gyroscope, which, by means of the Anschütz patent, was now made to act continuously during the run. The Davis torpedo was the invention of Cleland Davis, dated from 1908, and differs from the Whitehead in carrying a gun at the head. Whereas the Whitehead charge exploded in the open water and took effect on the outer parts, the Davis gun shot the charge into the vessel to explode inside. The extent of the damage resulting would probably be less, and would vary with the angle of the gun at the moment of discharge. There is no doubt that the Davis gun-torpedo can be made into an effective weapon. The torpedo was the deciding factor in the design of the submarine boat. Russia is building destroyers with 10 torpedo-tubes, and France has boats with 11 tubes.

The early future will see much more attention paid to the torpedo in large war vessels. The "torpedo ram" has come to life again. Russia is said to be building a submarine cruiser of 5400 tons displacement with 36 torpedo-tubes and 60 torpedoes.—Extracts from "The Development of the Torpedo," by Captän zur See S. Michelsen, Kiel.—*The Engineer.*

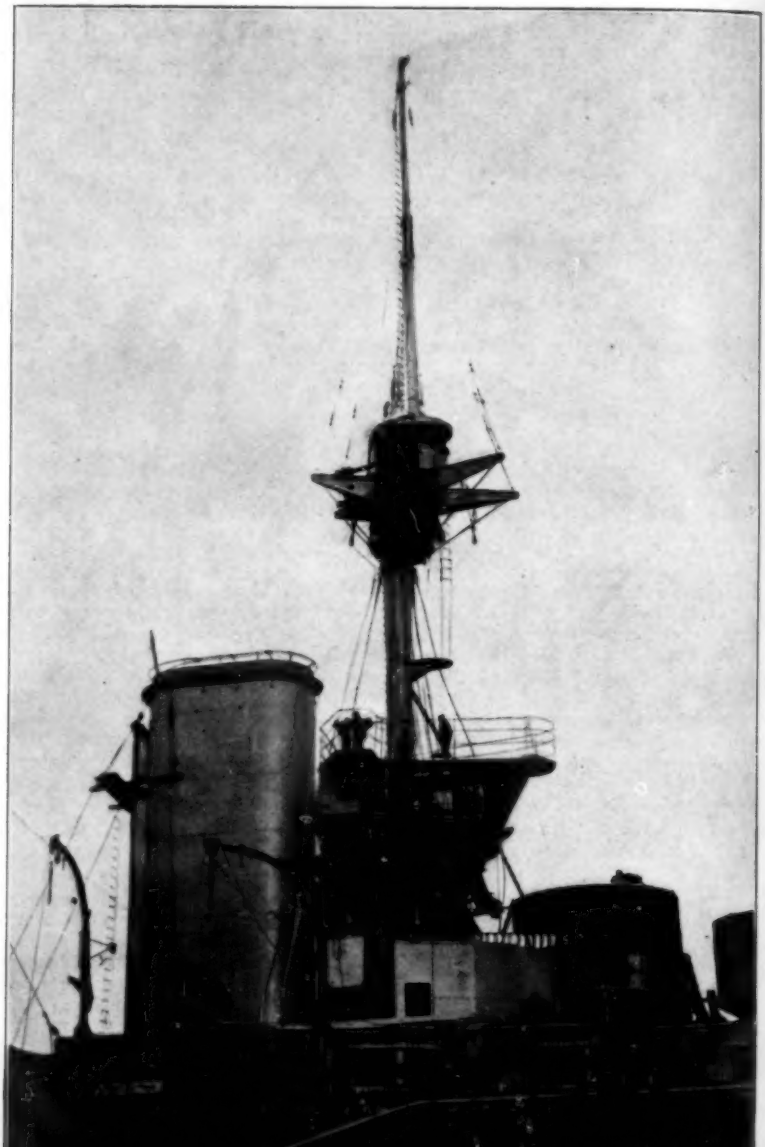
FIRE CONTROL.

CONNING- AND FIRE-CONTROL TOWERS.—Two photographs of these as installed on the battle-cruiser *Lion* and the battleship *King George V* are reproduced on the following pages.

The conning-towers of the recent English battleships are unusually large in order to provide space for the gunnery lieutenant or fire-control officer of the battery as well as the torpedo fire-control officer with all the instruments necessary.

Forward, the tower, due to a combination of the vertical armor, the armored deck, and the base of the 13.5-inch gun turret, is absolutely sheltered from direct impact of heavy shell. It is hoped these will glance from the oblique and curved armor surfaces presented.

THE FIRE-CONTROL POSITIONS.—The experiments which have recently been carried out on board the battleship *Thunderer,* in the vicinity of Bantry Bay, appear to have proved beyond doubt that in future ships, a more suitable place will have to be found for the fire-control instruments and their operators. During some periods of the trials the control position, we understand, became almost as hot as an oven, the operators being parboiled while carrying out their highly important functions. It seems that unless the ship is steaming against a strongish head wind it is next to impossible for the fumes and smoke from the foremost funnel to be carried clear of the men and instruments in the control position. As in action the course of a ship is constantly being altered, to obtain the weather gauge of an enemy and thus place the sun behind the sights of the gunlayers to prevent them having to fire at an object in the sun's eye, the wind naturally blows the smoke and fumes from the funnel straight at the control position for the better half of the time. That this would interfere with the efficient use of the instruments is very obvious, and consequently the gunfire would suffer from the lack of adequate control during that period. The sum spent on effecting alterations in the *Lion* was a very large one—about £50,000—but it is better to spend money for the purpose of making a ship capable of doing her best under all conditions, than to send a capital ship into action whose gunfire cannot be properly controlled because of the smoke and fumes from the funnel. These remarks appear to be specially applicable to the *Thunderer.—United Service Gazette.*



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"KING GEORGE V."

FIRE-CONTROL TOWER, TOP, IMPROVED TYPE CONNING-TOWER.
Note the Pole Mast, and Small Wireless.

SPOTTERS' STATIONS.—After the trials on the *Posen* the Germans are installing on board battleships a spotter's platform at the masthead from which to control the fire.—*Moniteur de la Flotte.*

SCOTT'S FIRE DIRECTOR.—The object of this is to rapidly concentrate the fire of all the available guns of large caliber on the broadsides, and then deliver a rapid succession of crushing blows on the hull and fittings, the armor and turrets of the enemy. Salvos and broadsides, when the latter

H. M. S. "LION."

The conning-tower and spotter's top.

are possible, are used for this purpose, but the gun-fire is so arranged that the smoke from one gun shall interfere as little as possible with the fire of its neighbor, and this is not an easy matter, but one which requires to be arranged by careful thought and on scientific principles, and this is the first time a solution has been found for the handicap that smoke and blast invariably impose. A ship in action is likely to have the wind from all directions by the varying of the ship's course when maneuvering for the best position, and this causes smoke obstacles, which if not scientifically overcome, places half the armament out of action for quite half the time. The Scott system is intended to remove this handicap as much as possible.

During the latter half of last century, when muzzle-loading rifled guns, carrying to a long range, came into play, broadside firing was also brought to a higher standard of accuracy by means of electrical apparatus for firing and improved means of concentrating the guns. During the last few years the improvement has continued in the means of accurately finding the range; but concentrating guns and broadside fire has remained more or less stationary. By the new Scott method broadside fire is once more raised to a high point of efficiency, and a stunning blow can be dealt out to an enemy

The Fleet.

AN ENGLISH CENTRAL STATION.

THERE ARE OTHERS!

at 10,000 yards. In fact 20 to 30 per cent of gunnery efficiency has been added to naval guns, under this plan of concentration, at a single bound. There is no competition between Sir Percy Scott's apparatus and the old methods, because the former is chiefly adventitious aid to the gunlayer, whereas the Scott arrangement deals with concentration and a smashing broadside blow.—*United Service Gazette.*

The battleships *Orion, Monarch, Thunderer,* and *Neptune* are the ones so far fitted with this apparatus.

DIRECTOR TESTS ON THE "THUNDERER."—Advices to hand relative to the trials which took place in September with Vice-Admiral Sir Percy Scott's "fire director," fitted in the battleship *Thunderer*, confirm the tests made originally in the battleship *Neptune*, as to the accuracy of fire obtained by the use of the invention.

Those who were responsible for carrying out the trials speak in terms of high praise of the new instrument which renders it possible to begin an action at over 10,000 yards, with the certainty of hitting, thus rendering the secondary armament of possible rivals virtually ineffective. It is not too much to add that the introduction of this scientific aid to straight and rapid fire means 20 to 30 per cent increase in efficiency.

The important firing trials of the main armament of the battleship *Thunderer* controlled by the new Scott fire director were supplemented by a series of comparative experimental trials in heavy weather, in which the *Orion*, *Thunderer*, and *Monarch* were engaged. Each of these battleships is provided with range-finding and fire-control instruments, and carries a similar armament to the *Thunderer*, viz., ten 13.5-inch guns mounted along the center line; hence the trials, in which the capabilities of the new fire director as compared with the latest ordinary range finders were exhaustively tested, are considered to be the most important since the introduction of the all-big-gun type of ship.

The trials took place in heavy weather, vessels rolling over 5 degrees.

Accuracy of Fire Unprecedented.—During the last few days most interesting experimental tests with Vice-Admiral Sir Percy Scott's "fire director" have been made on board the battleship *Thunderer*, which was recently sent to Berehaven for the purpose of calibrating and making confidential trials with the "director." Four broadsides were fired and the accuracy of fire is reported to have been unprecedented.—*Naval and Military Record.*

The *Thunderer* fired four times, and each time she went out from Bantry Bay other ships accompanied her and did battle practice, so as to enable a direct comparison to be made of firing under similar conditions of wind and weather. The actual results are kept secret, but it is known that the "director" system was a great success. The *Thunderer* fired broadsides, generally of five guns, but sometimes of ten, and the target was left in a battered condition.

The *Thunderer* and *Orion* then fired simultaneously at different targets, so as to ascertain which vessel could make the most hits in a given time, and thus tested the relative merits of the director and fire-control systems.

The *Orion* carries the fire-control equipment which was adopted by the Admiralty some years ago and has helped largely towards bringing about the present standard of gunnery efficiency in the British fleet.

The *Orion*, which now bears the flag of Rear-Admiral Rosslyn E. Wemyess, has proved to be a good gunnery ship, and has also the advantage of having been in commission over ten months, whereas the *Thunderer* was not commissioned until June 15—an important difference in a matter which depends largely upon the gunnery department of a ship's company.

The trials were carried out in the presence of five flag officers, viz., Vice-Admiral Sir John Jellicoe, in the *Hercules*, flagship of the second squadron; Vice-Admiral Sir Percy Scott, in the *Thunderer;* Rear-Admiral Rosslyn Wemyss, in the *Orion*, flagship of the second battle squadron; Rear-Admiral Sir George Warrender, in the *Indomitable*, flagship of the second cruiser squadron; Rear-Admiral Montague Browning, inspector of target practice; and Rear-Admiral R. H. Peirse, a former inspector of target practice.

No results have been given out, but it is known that the salvo dispersion due to errors impossible to eliminate indicated in the firing, made neither system seem better than the other.

In the rough weather tests, however, the *Thunderer* made five times as many hits as the *Orion*, and completely eclipsed all previous records of

firing, including those obtained in fine weather. Her broadsides, sometimes from five and sometimes from ten guns, seemed to rain on the target.

FRENCH FIRE-CONTROL NOTE.—French battleships are now having the Janney system of pointing fitted to their guns, and the Leconte-Aubrey instruments for fire control installed. Details of these systems are not known.

THE SKELETON MAST TESTS.—A test mast was erected on the *San Marcos* and inclined at 15 degrees from the vertical and the top weighted considerably. About thirteen 12-inch high-explosive shells were fired and the lattice work damaged severely. The mast fell finally, all its elements being cut. The target presented by the mast is not one-tenth of that presented by a battleship, hence a ship would be hit 120 times before the mast would fall. That the result of the test is considered satisfactory is indicated by the fact that the *Pennsylvania* will have cage masts of the standard service type.—*Moniteur de la Flotte.*

POWDERS.

FRENCH POWDER INQUIRY COMMITTEE.—The committee of inquiry, of which General Gaudin is president, on the subject of powders believe they have found the cause of the terrible disasters in the past.

The formula of powder B, due to M. Vielle, is of itself good, only when the care of manufacture is of a very high order. The slightest impurity in any of ingredients will cause reactions strong enough to decompose and ignite the powder. The main offence in lack of care has been in the purification of the raw cotton.

Austria and Russia have never had trouble with powder B where its manufacture is conducted with the greatest care and attention to detail.

M. de Chardonnet says that the cotton and the nitric acid are the materials needing closest watch. The nitration must be absolutely homogeneous. Fibers badly nitrated decompose easily, especially in the conditions found on board ship. Vielle powder made with proper care is free from any danger of decomposition.

M. Delpech says that powders chemically pure are transparent, that M. Vielle's formula is not perfection, but produces a mixed material, porous, and very sensitive to moist air. Our sailors all know that American and Russian powders are greatly superior to their own, in uniformity of material as well as density. Our powder makers should swallow their pride and copy methods of foreigners because the latter have better success than we do.

M. Painlevé, rapporteur of the naval budget, says that French powder manufacture has been isolated from supervision, separated from everyone by a true wall of China. This industry, on the contrary, in other nations has been subjected to the closest scrutiny with no obstacles put in the way of inspectors. There are two things we can do, either,

(a) Manufacture our powder carefully, or

(b) Adopt nitroglycerine powder. Germany, which manufactures most methodically all kinds of modern powder, has adopted for its army nitrocellulose, similar to powder B, and employs for its heavy ordnance, and consequently for its navy, nitroglycerine powders.

M. Bénazet (rapporteur), of the powder budget, says that an excess of sulphuric acid has crept into the mixed acids quite frequently. The proportion of half sulphuric and half nitric is as high as is safe, but yet 660 parts by volume to 1000 parts by volume, sulphuric to nitric has been common, and, in the pyroxyline manufacture, of which he has had much experience, productive of many spontaneous ignitions.

The conclusion reached is that if purification of raw materials, and manufacture be accomplished, no more radical solution of the powder problem is necessary.

THE FRENCH MISTRUST OF THEIR POWDER.—M. Painlevé recently, on being interviewed at Brest, said:

"My conviction is stronger than ever that it is criminal to wait longer before making a radical solution of the powder problem. The powders landed by the third squadron would have to be re-embarked in case of a mobilization, but I believe that nobody would dare to give such an order. The result of such an order would be deplorable.

"In the firing of the third squadron they used only charges put up in cartridges and not a single bagged charge. This powder question then is the most urgent problem before Parliament. I strongly hope that the discussion on the naval appropriation will not end without the necessary decisions being made.

"It is necessary to control private industries, break the monopoly, and manufacture powder in government factories."

MARINE ENGINEERING.

OIL-FUEL CAPACITIES.—That of the *Nevada* class is 598,400 gallons or 2350 tons; of the new British battleships is to be 2500 tons, though this has lately been denied; of the *Gangoot*, Russian, is 1170 tons in addition to coal, and the *Courbets*, French, and *Orions*, English, carry 1000 tons in addition to coal.

OIL STORAGE.—The navy oil depots at Kiel and Wilhelmshaven are to be enlarged. This announcement indicates the growing use of oil, if not as a prime mover, at least as an auxiliary fuel for German ships. All large German war vessels laid down to date are coal burners, but most of the newest are fitted to burn oil as well as coal. Meanwhile, reverting to the Diesel oil engine, two engines with a designed horse-power of 12,000 or slightly over have been constructed to government order, one at Nuremberg and one at Kiel, and a third marine engine of greater power is in hand. As no sane government would order such costly engines without a definite objective, it is fair to assume that Germany will be first in the field with oil-driven war craft. In so far as it lies open to public study, German naval strategy has one or two gaps which would be filled admirably by such craft. This scheme of strategy deals largely in "diversions" to be made with the aim of compelling the strongest naval power to divide its forces, and the strategists in Berlin consider that this division can be brought about most surely by interfering with the enemy's food supply. Some authorities hold the battle-cruiser to be the ideal type for this operation, but they are in a minority. Others pin their faith in the oil-driven cruiser of moderate tonnage and respectable speed, whose great value will reside in her complete independence of fuel bases for months on end. When Germany adopts the Diesel principle in earnest, it is almost certain that it will be represented first of all in a commerce-destroying type of cruiser.—*Naval and Military Record.*

PERFORMANCE OF A TOSI TURBINE.—The trials of the destroyer *Indomito*, built by the "Societa Officine e Cantieri Napoletani C. & T. T. Pattison," of Naples, were recently held. This vessel is the first of the six destroyers withTosi turbines being built by the firm for the Ministry of Marine. The *Indomito* destroyer has a displacement of 680 metric tons and is 73 metres long, 7.32 wide, and 4.82 deep. She carries four tubular boilers, two Tosi turbine engines, constructed by Messrs. Franco Tosi, of Legnano, and each driving one of the two propellers. The two turbines, of 15,000 horse-power, estimated, gave during a three hours trial a speed of 35.09 knots, much greater than that specified in the contract, thus the *Indomito* is the swiftest craft in the Italian Navy. The excellent results obtained both from the point of view of working and consumption, in spite of the somewhat limited weight and dimensions of the turbines, as required in torpedo-boats, are

the more remarkable, because these turbines were invented and made in Italy and have numerous novel features.—*Marine Engineer and Naval Architect.*

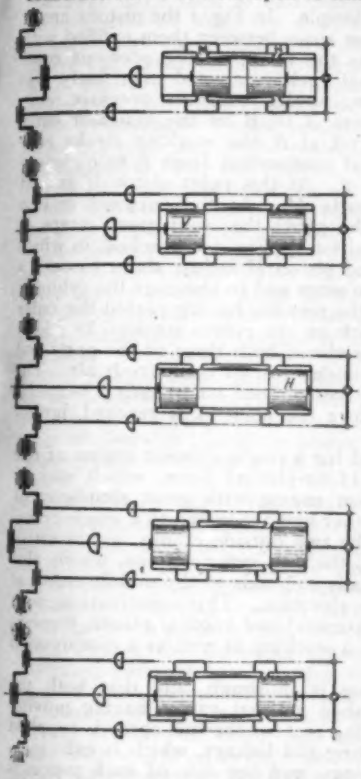
WARSHIPS SPEED TRIALS.—The circumstances that the steaming trials of the British *Princess Royal*, the German *Kaiser*, and the Italian *Dante Alighieri* are being run about the same time affords ground for several interesting comparisons, but the value of such comparisons must be entirely dependent upon the fulness and reliability of the reports of the vessels' performances. It is not enough to have the speed which each ship developed without knowing also the state of the sea and the weather, whether the vessel was fully loaded or running light, and by what method the speed was reckoned. In fact, at present we have not sufficient knowledge of the elements and conditions under which recently completed warships have been tried which might enable us to form a common standard for comparison. The *Kaiser's* reported speed of 23.6 knots is, therefore, interesting, but it would be more convincing to learn that the vessel had made such a speed under the actual service conditions. The battle-cruiser *Moltke* was credited with the fine speed of 29.47 knots on trial in September, 1911, and when she was chosen to visit New York in the spring of this year there was every anticipation that she would attempt to lower the trans-Atlantic record of the *Indomitable* on her return journey. But she did not succeed in doing so, and the speed at which the return trip was made has never been made known, though it would certainly not have been concealed had it exceeded that of the *Indomitable*. As regards the speed achieved with the *Kaiser*, however, the Germans have reason for self-congratulation, since this first turbine-driven battleship in their navy has achieved a rate exceeding that of any other battleship of which detailed results have been made known. The *Conqueror*, with 23.25 knots, would seem to have made the nearest approach to it. The *Dante Alighieri*, claimed by the Italians to be "the fastest *Dreadnought* battleship in the world," is designed for 23 knots, but her trial speed is not yet known. Meantime, the steaming performances of the battle-cruisers *Lion* and *Princess Royal* remain unequalled by any navy in the world.—Editorial in *Army and Navy Gazette*.

THE JUNKERS OIL ENGINE.—Prof. H. Junkers, of Aachen, Germany, has developed a remarkable internal combustion engine utilizing the combustion (not explosion) of cheap, low-grade liquid fuels by the compression-ignition method of the Diesel engine, but with certain radical improvements in design which give increased efficiency and adaptation to all power purposes.

Just as Watt is the father of the steam engine in its manifold forms, so in our own day Dr. Diesel is recognized as the first worker in the field of the internal combustion engine burning cheap fuel. Now comes the Junkers engine as a radical improvement in this field. Existing engines utilizing cheap fuel oils to generate power at economies unattainable in the best compound steam engines, have left much to be desired for certain stationary and marine applications, and have been inapplicable to locomotive propulsion. The need has been for an engine which could generate cheap power from low-grade oils—down to even the asphaltum oils and their residues—not only for all stationary purposes, but for propelling vessels under practical conditions and for driving locomotives.

This need is now filled in the Junkers oil engine, in which the combustion of the fuel charge in a single cylinder urges two pistons in opposite directions. The cylinder is a simple tube, open to the atmosphere at both ends—no cylinder heads, no stuffing-boxes, no valves with mechanism. The greatly superior heat efficiency, high aggregate piston speeds with low speed of each separate piston, better scavenging and cooling and lower cooling losses, and the absence of valves enable this engine to show a marked reduction of weight per horse-power—down to less than one-half, in some

cases one-quarter—and a decided increase in efficiency when underloaded and in overload capacity. The design allows higher speeds and also a greater range of control of speed. Actual engines in use include the propelling equipment for twelve ocean-going vessels now under construction, stationary engines being manufactured by prominent European companies. At present a locomotive of 2000 horse-power, designed for a speed of 125 kilometers per hour, and weighing less than a steam locomotive, is under construction. The field open to this type of prime mover is indicated by the



Figs. 1 to 5.—(Reading from top to bottom) diagrams showing operation of single-cylinder Junkers engine.

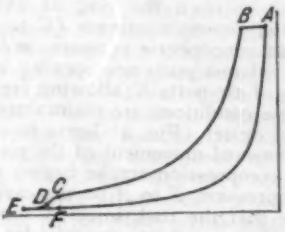


Fig. 6.—Typical indicator card.

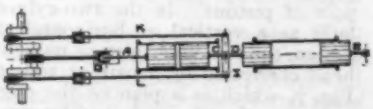


Fig. 7.—Elementary plan of two-cylinder horizontal tandem engine showing connecting-rod system for the two inner pistons operating on the side cranks.

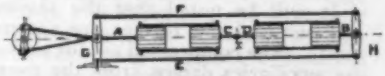


Fig. 8.—Elementary side elevation of two-cylinder engine showing connecting-rod system for the two outer pistons operating on the center crank.

fact that it consumes any cheap liquid fuel, even including asphaltum crude oils.

Without dwelling on technical details, the fundamental principle of operation of the Junkers oil engine may be understood by an inspection of the annexed schematic diagrams (Figs. 1 to 5) of a single cylinder engine—cylinder and pair of pistons, and the connecting rods and cranks of the engine in five successive positions throughout one revolution—in conjunction with the indicator card (Fig. 6).

The arrangement of parts in the five diagrams is clear on first inspection in all but one feature. The obvious features are the open cylinder without cylinder heads, the two pistons moving alternately outward, that is away

from each other, and inward or toward each other, the left-hand piston *V*, being connected directly to the middle one of three cranks and the right-hand piston *H*, being connected to a cross head and a pair of parallel connecting rods to the two outer of these cranks 180 degrees from the middle crank; and the movement of the pistons, successively outward and inward, thus turning the main shaft. The object of the ports *M* and *N* will be understood as the operation of the engine is traced through one complete revolution.

The engine works on the two-cycle principle. In Fig. 1 the pistons are at the inner dead center, and the combustion space between them is filled with highly compressed, highly heated air as the result of the previous compression stroke. In this position the oil fuel is injected in a finely dispersed condition, igniting and burning under constant pressure during the first part of the outstroke (from *A* to *B* on the indicator card, Fig. 6). With the supply of fuel cut off at *B*, the working stroke continues with expansion of the products of combustion from *B* to *C*, bringing the pistons to the position of Fig. 2. At this point piston *V* is just about to open the ring of exhaust ports *M*. As the outward motion of the pistons continues (*C* to *D* on the card) the spent gases escape at about atmospheric pressure, and the position of Fig. 3 is reached, in which the exhaust ports are opening wider and piston *H* is just about to open a ring of air-ports *N*, allowing fresh air to enter and to scavenge the cylinder. These conditions are maintained until the pistons, having passed the outer dead center (Fig. 4) begin to come back on the return stroke. In Fig. 5 the inward movement of the pistons has closed both rings of the ports and the compression stroke begins on a cylinder full of cool, fresh air. The compression, *F* to *A* on the card, heats the confined air to such a temperature that the fuel, injected shortly before the point *A* is reached, ignites as it is sprayed into the cylinder.

The above is the complete cycle traced for a single cylinder engine of one pair of pistons. In the two-cylinder (four-piston) form, which may be built as a vertical or horizontal tandem engine with great simplicity of design, the two inner pistons move together and are linked to a single crosshead connected by a pair of rods to the two outside cranks, as shown in Fig. 7, which is a plan of the engine; the two outer pistons, which also move together, being linked by crossheads and rods to the middle crank at 180 degrees, as shown in Fig. 8, a side elevation. This construction, with two pair of connecting rods, in the horizontal and vertical planes, respectively, makes every stroke of the engine a working as well as a compression stroke.

It will be noted that the scavenging is thorough, and that both the exhaust and the former are accomplished without valves having moving parts. The compressed air for scavenging and for the fuel spray is supplied by auxiliaries driven from the connecting-rod linkage, which is extremely simple. The cylinders are simple castings, and one side of each piston is always exposed to the atmosphere and comes to rest at every outward stroke in a well-cooled region of the cylinder not touched by the products of combustion. This secures perfect cooling and lubrication. Finally, owing to the division of the total stroke between two pistons in each cylinder, a high-piston speed is attained with low individual piston speeds, and a long cylinder of small diameter, most favorably adapted to thorough scavenging and to perfect combustion, may be used.—Joseph B. Baker, *Scientific American.*

THE TURBINE AND BATTLESHIPS.—With the extensive adoption of turbine propulsion which has been so marked a feature of marine engineering during the last decade, and with the eyes of progressive engineers all over the world now turned to the experiments on a large scale which are being made with the later developments of the oil engine for marine purposes,

it is perhaps excusable if one should have come to think that the battle between the older system of steam reciprocating engines, and the newer one of steam turbines had been fought to a finish, but this is apparently by no means the case. In a trenchant paper delivered by Captain C. W. Dyson to the Engineers' Club of Philadelphia in January last, the author appears in his usual effective style, and reveals himself to be somewhat of a special pleader for the steam reciprocator as still the best system of propulsion for large units such as battleships and fast liners. Whilst ceding to the turbine pride of place for such vessels as torpedo-boats, destroyers, and scouts, where speed and power are high, and the hull structure light, he makes out an exceedingly strong case for the steam reciprocator on battleships where the engine foundation is substantial, and the speed more moderate. Early experiments in America with the marine turbine were a little unfortunate, Curtis turbines were fitted in the Southern Pacific steamer *Creole* and in the yacht *Revolution*. In each case the result was unsatisfactory, and the engines were removed from these vessels. The *Creole* had water-tube boilers, which caused an element of doubt in some minds, but when reciprocating engines took the place of the Curtis turbines the ship attained a high efficiency, demonstrating the fact that neither hull efficiency nor boilers were contributory causes to the want of success. Soon after this the United States Navy carried out very exhaustive trials with three scouts specially fitted to throw light on the relative merits of the systems of propulsion then under discussion. The *Birmingham* had steam reciprocating engines, the *Salem* Curtis turbines, and the *Chester* Parsons' turbines. In this contest the Parsons' turbine was considered to have scored an easy win. On the whole, although the *Creole* was not a success, the turbines were reported upon by navy experts as adapted for marine propulsion. It should be stated that at this period most stress was laid upon efficiency at maximum power, and it was only at a later date that the relatively poor results given by turbines at low cruising speeds became insistent.

In 1907 the United States Navy decided to build two battleships to be called *Delaware* and *North Dakota*, the former to have reciprocating engines of the most advanced type, and the latter Curtis turbines. Exigencies of design did not allow of Parsons' turbines being adopted, engine-room space limitations preventing. Every endeavor was used to make the reciprocating engines as perfect as possible, auxiliaries and main engines alike being designed with the greatest care. As compared with the older types of reciprocating engine, the following changes were made on the Delaware: (1) Increased ratio of low-pressure to high-pressure cylinder capacity were adopted; (2) steam valves were modified to give short straight steam and exhaust ports; (3) steam was subjected to 60 degrees of superheat; (4) bearing pressure on crank pins and crossheads was reduced; (5) forced lubrication was fitted to the crank-shaft, crank-pins, crosshead journals, and slides and excentrics. All this greatly improved the efficiency of the engines, with the result that a comparison of the trial data with those of older types showed that with an air pressure of two inches, which is the limit with coal-burning Babcock & Wilcox boilers, the improved engine gave 25.6 indicated horse-power per square foot of grate, as against 20.6 indicated horse-power per square foot of grate with the older type, an increase of economy of 24.3 per cent. The author attributes 6 per cent of this to superheat, and the remaining 18.3 per cent to increased mechanical efficiency. He gives a comparison of the water consumption of this vessel with that of the scout *Birmingham*, not quite a fair thing to do, perhaps, but these were the only two ships upon which water consumption measurements on trial had been made, of which the data were available. The result he gives as follows in pounds of water per indicated horse-power: *Delaware*, at full power, 13.38 pounds; at five-eighths power, 12.7 pounds; at one-eighth power, 15.12 pounds; *Birmingham*, at full power, 17.3 pounds; at five-eighths power, 15.5 pounds; and at one-eighth power, 19.0 pounds.

The superiority of the *Delaware* is very great, but we think it will be conceded that the water consumption is exceptionally good for reciprocating engines, and one is inclined to doubt the probability of attaining that degree of efficiency in all cases. As confirmation of this result, however, the author quotes trial data of a collier, the *Cyclops*, whose engines, of about 7200 indicated horse-power, were built on battleship lines. In this case the water per indicated horse-power worked out at less than 12 pounds, neglecting leakage and cylinder condensation. It is upon such a basis that the comparison with the turbine-engined *North Dakota* is made, and not upon the more usual results obtained, as in the *Birmingham*. This is, perhaps, quite in order, since Captain Dyson has been so successful in obtaining such a marked advance in the reciprocating engine. At the same time it should be remarked that the *North Dakota* did not represent the full possibilities of the turbine engine, nor even of the Curtis turbine, for it was of an early type, and necessarily still going through the infantile troubles which are incident to all new departures. There are building at present turbines which will give as good or perhaps better results than those of the *Delaware* even low speeds.

The case for the turbine is categorically stated in the paper, and most of the claims which are made for it negatived. These are: (1) Turbine engines are capable of being driven for long periods at high power without derangement, and less work is required to keep them in condition than reciprocators. The author claims that the *Delaware* has proved herself capable of the same lengthened service, and that, moreover, when anything does go wrong with a turbine engine it is a case of hospital treatment, the trouble being often blade stripping, especially of cruising turbines when running in vacuum. He maintains that the engine-room staffs differ very little in the two cases.

(2) There is less vibration with the turbine, and therefore more accurate gun-laying. Captain Dyson contends that with well-balanced reciprocating engines, on such a foundation as a battleship provides, the older engine offers no disabilities in this respect, and quotes the cogent fact that the *Delaware* has won the battle trophy for gun-laying, beating the *North Dakota* easily.

(3) Less boiler equipment is required to develop the power necessary for full speed with turbines—against which is marshalled the splendid water consumption of the *Delaware*, and the fact that the propeller diameter made necessary by the high revolutions of the turbine involves a lower propulsive efficiency, and so counteracts any advantage the turbine may have in this respect. Results are given of trials with the three battleships *Delaware*, *North Dakota*, and *Utah*, the latter having Parsons' turbines. Taking propulsive efficiency to be represented by effective horse-power with excrescences ÷ indicated horse-power for the *Delaware*, and effective horse-power with excrescences × .92 ÷ shaft horse-power for the turbine ships, 8 per cent being allowed for engine friction, he gives:

	Delaware, Reciprocating.	North Dakota, Curtis turbines.	Utah, Parsons turbines.
Speed, knots	21	21	21
Revolutions	122.5	265	313
Propulsive coefficients	65	53.82	56.12
Speed, knots	12	12	12
Revolutions	66.5	140.75	192
Propulsive coefficients	69.3	61.32	53.18

Furthermore, he states that the *Delaware* showed herself to be 20 per cent better in bad weather, and 44 per cent better in good weather than the *North Dakota* when on a cruise with the fleet from America to England and back. These discrepancies are enormous, but are qualified by the fact that

the turbines were found to be damaged by erosion and corrosion when subsequently opened up.

The author flatly denies the claim that the turbine demands less floor space. He grants greater economy of lubricating oil, but not of fuel oil. He also grants greater cleanliness in the engine room, but only at high speeds, and he agrees that the turbine has a greater capacity for overload without allowing any special virtue in the quality. No advantage is claimed for turbines on the score of weight; the *Delaware's* engine-room weights were 773 tons, and those of the *North Dakota* 783 tons—a negligible difference.

On the whole, then, the turbine as applied to battleships and to fast liners has to face a very strong indictment, and it cannot be denied that the case rests mainly upon the splendid performances accomplished by Captain Dyson with the *Delaware*. No mention is made by the author of one valuable feature exhibited by the rotary engine as against the reciprocator, that is, the increased length of life which may be expected from the shafting of turbine engines, they not being subjected to the continuous alternations of stress which are present with even a well-balanced reciprocating engine, nor to the ease with which the turbine engine may be protected from gun fire, owing to its low position in the ship well below the water-line.

The position taken up by the navy authorities of the United States with regard to the engines of the lighter units is clearly indicated by the simple announcement that the last eight vessels of this class ordered are all to be turbine driven, and all to be twin screwed. For these vessels there is no question of the superiority of the turbine, and it seems to be agreed that the twin-screw arrangement offers more advantages than the triple. Captain Dyson makes no reference to recent developments with geared turbines, but the late Rear-Admiral Melville in the discussion warmly advocated this feature, and claimed that the future of the turbine depended upon the attainment of better propeller efficiencies, by means of reduced revolutions, either by gearing or by electrical transmission. Whether direct-driven turbines of combined impulse reaction type will eventually make this complication unnecessary or not it is difficult to say, but it is certain that simplicity, if not too expensive, is always a quality to be aimed at, and direct driving is simpler than gearing.

The paper is of the greatest interest, and puts the whole question of battleship propulsion in a new light. The author with his clear-cut analysis and telling facts is difficult to refute, but we believe the answer to him is just that he has compared the very latest and most ingenious reciprocating engine practice with one form of turbine mainly, and that in its early stages of development, which is obviously unfair. The comparison should rather be made between the best that is likely to be accomplished with reciprocators in the future, remembering that all possible improvement seems to have been made, and the promise that is held out by the best types of turbine in combination with suitable propellers, and here who shall limit what the future holds, in view of what has already been and is being accomplished. Much of the ground is quite new, specially that upon which rests the problem of the best way to adjust the differences between the requirements of the propeller and the turbine for good efficiency.—Editorial in *The Engineer*.

RADIO.

THE RADIO STATION AT ARLINGTON.—This station is now completed and in working order. A lieutenant in the navy and twelve enlisted men comprise its crew. At a designated hour daily messages covering official business with the fleet are radiated to American warships. Daily hydrographic reports, notices to mariners acquainting them with the existence of derelicts and icebergs or other information, are sent to merchant vessels in the steamer lanes.

Only one other similar structure in the world is as high from the ground as the central tower at Arlington, and that is the great wireless steel tower

at Nauen, near Potsdam, Germany, which was completed last February and is able to communicate with America. Unlike the Arlington arrangement, the Nauen station has a single steel tower, 650 feet in height, around which spread like umbrella ribs a series of thirteen wooden masts, each 128 feet high, from the peaks of which antennæ stretch 650 feet long.

The Arlington station will not be able to receive messages from the distance to which it can send them; at least not from every plant with which it may communicate. The plant at Arlington is powerful enough to receive any message that may reach it. But in the beginning of its existence few, if any, of the great stations will be able to send messages regularly a like distance under ordinary conditions, and few craft, even under the most favorable weather, are able to send a message over a thousand miles. A vessel with a ten-kilowat naval radio plant may send a message 800 miles, under ordinary circumstances, and 2000 or more miles when the atmosphere is freakish. With a sending radius of 3000 miles in ordinary weather, the Arlington station is expected to have a sending radius of 4000 or 5000 miles in freak weather, and it is thought that some time during its history the Arlington station may experience a peculiar condition of weather which might enable it to send even as far as Japan.

To avoid smoke, dust and vibration the power for the operation of the plant is derived from the electric conduits of the city of Washington. This power drives a 200 horse-power electric motor, which in turn drives what is described as a 100-kilowat 500-cycle alternating generating plant. Two currents, one of which is primary and of 100 volts, the other secondary and of 12,500 volts, are produced by this generator. The primary current passes into a novel transformer, which "steps up," and is increased into a high current of 12,500 volts in the secondary circuit.

The two wings of the station are separated by short vestibules from the central machinery plant. These vestibules are wooden. The connections of the vestibules with the brick work are padded with linofelt, which takes up the vibration from the machinery plant and avoids corresponding complications in the operating rooms. There are two of these rooms. One is occupied by the radio operators, the other by those who man the telephone and telegraph wires connecting the station with the outside world. The radio operators' room is unique. It is built somewhat upon the style of a huge refrigerator. It is absolutely sound-proof, and when its door is closed the radio operator on duty cannot be bothered by any sound from without or vibrations. The only entrance into the radio operating room is through a double refrigerator door. The room has no windows, is artificially lighted and ventilated. Even the air used in doing this is sound-proof, as it passes through a series of air ducts in which "baffle plates" are strung so as to baffle any noise that may attempt to creep with the ventilation into the radio operating room.

A separate room has been set apart for use by operators of the land wires. Connecting it with the sound-proof radio operating room is a telautograph. When a message is to be sent by wireless it is not taken through the refrigerator door into the radio operating room, but is laid down there by the outside operator through use of the telautograph. The outside operating room does not have to be storm and vibration proof and is connected with the outside world in three ways: by public telegraph, and private and public telephone. There is a private telephone wire leading direct from this outside operating room into the Bureau of Navigation in the Navy Department. This avoids any leak of official messages through use of the city telephone service. Should anything happen to this official wire the plant has another telephone connection through the regular city switchboard. Within reach of this outside operator are keys connected with the telegraph systems of the Postal and Western Union companies, by means of which any wireless message may be relayed over land wires to any part of the United States.—*Army and Navy Journal.*

THE RESTRICTION OF WAVE-LENGTHS BY THE LONDON RADIO-TELEGRAPHIC CONVENTION.—The specific prohibition of the use for public service of wave-lengths between 600 and 1600 meters, the stipulation that all ship communication shall be on either 300 or 600 meters wave-length (with the possible use of 1800 meters for long-distance transmission) and the cumbersome form of sending messages would seem likely not only to work an extreme hardship upon corporations engaged in commercial radio-transmission, but also to bring about a considerable decrease in service efficiency.

The fundamental wave-lengths of ship antennas average about 400 meters, with extreme points about 150 meters above and below. Modern transmitters operate efficiently at wave-lengths from about one and one-fifth to say four times the natural wave-length of the antenna used and give best results at about two and a half times this. Therefore, the working ranges of wave-lengths for small, average and large ships are 300-1000, 480-1600 and 660-2200 meters respectively. Since it is considered impossible to transmit with good efficiency at wave-lengths below the antenna fundamental, it is very evident that in prohibiting the range between 600 and 1600 meters the government has effectually prevented ship-to-ship and ship-to-shore signaling under the best conditions. This is without regard to the effect of atmospheric absorption, which causes remarkably rapid attenuation when wave-lengths less than 800 meters are used and so increases the difficulties of transmission with short waves.—From an Editorial in *Electrical World*.

The regulations adopted by this convention may be found in full in *Electrical World* of September 28, 1912, page 648.

THE BETHENOD WIRELESS SYSTEM.—The distinguished French scientist, M. Bethenod, states that the descriptions already given of his newly discovered system of wireless telegraphy have not been at all accurate. His invention, he states, is not an improvement on the apparatus system of communication, but the discovery of an entirely new principle of wireless. All scientists had for a long time been searching for a sparkless wireless. Some had succeeded, notably the American inventor Alexander Anderson, but the machines thus made are high frequency alternators, with which the Bethenod system has nothing to do. Machines like Anderson's, said M. Bethenod, are really toys, for they are extremely expensive, and are able to emit only 6000 meter waves. Bethenod's machines are solid and practical and can give 60,000 meter waves. To give the others the same power, if it were possible, would cost millions of dollars.

M. Bethenod's apparatus is in two parts, the machine proper and the antennæ, both being special. The spark is suppressed and the oscillation is produced by special machinery. A very important point, and this was the important object aimed at by the discoverer, is the production of long waves. The difficulty with the present wireless is the short wave, with whose progress all other short waves in the atmosphere interfere. Long waves are not troubled or interfered with by the short ones. The longer a wave is the less it deteriorates. The long waves emitted by Bethenod's apparatus are completely independent of the phenomena of nature. Moreover, the short waves cannot mathematically be measured accurately. One can possibly be measured, but the next one cannot, owing to the depression. On the contrary Bethenod's waves are all measured mathematically and very accurately. Before launching a wave he knows its mathematic measure, for he is a very distinguished and scientific mathematician. The production of long waves and their measurement is the great problem whence, as all scientists know, will float the greater application of wireless to telegraphy and telephony and rapidity of transmission.

M. Bethenod has made numbers of practical experimental applications, notably between Paris and Brussels. He used the existing supports or masts, and then after carefully testing the antennæ sent an experimental 2000 meter wave. He next used an apparatus which allowed a 20,000 meter

wave. He measured the waves and found the communication by the long wave better than by the shorter one. In this connection a very important result was found, that the long wave was obtained with the same antennæ and supports—that is to say, at exactly the same expense as the short one. He was so well satisfied with the results obtained that he has ordered machinery of high power, and hopes in a few months to be able to communicate from Paris to America. He states that his wireless messages will not be intercepted, that other stations will not interfere on account of the great length of the meter waves, but if a post wishes to intercept a message that can easily be effected, and that secrecy of transmission is a separate problem.

Such are the claims of the inventor, which, it is to be hoped, can be fully substantiated, for wireless, though still in its infancy, has already demonstrated its great value, and its achievements thus far justify its inclusion among the wonders of the world.—*Army and Navy Journal.*

AERONAUTICS.

The German naval dirigible of the Zeppelin type carries a crew of two ordinary naval officers, one engineer officer, one special pilot, and ten men. Hamburg has been selected as the headquarters for naval dirigibles. The aeroplane headquarters are at present at Danzig.—*The Engineer.*

THE GERMAN NAVAL AIRSHIP *L. 1.*—On the 17th of October the first Zeppelin airship of the German Navy was taken over by the government. The *L. 1*, which has been constructed at Friedrichshafen under the supervision of Count Zeppelin, is about 525 feet long, 50 feet in diameter, and has a cubic capacity of 706,300 cubic feet; it has three Maybach motors, one in the front gondola and two in the back one, each with a capacity of 170 horse-power; the balloon consists of eighteen gas cells. The forward propellers, which are of aluminium, have two blades and the rear propellers four blades. The horizontal steering gear has six vertical surfaces and the elevation steering gear eight horizontal surfaces. An observation platform of sheet aluminium is erected on the top of the balloon, which is reached by means of a shaft. In the gangway between the two gondolas is a room for officers and men, in which wireless telegraphy apparatus is fitted up. Arrangements have been made for bomb-throwing in time of war. After a few trial trips of small extent made at the beginning of the month, the airship set out from Friedrichshafen on the 13th with twenty-one persons on board, among whom were the Government Examining Committee and Count Zeppelin, and after remaining in the air for thirty-one hours, landed at Johannisthal. The journey proceeded by way of Bielefeld to Norddeich, on the North Sea, and then eastwards via Helgoland, Kiel, Lübeck and Hamburg to Berlin, a total distance of about 1050 miles, the average speed being 33 or 34 miles an hour. The *L. 1* is stated to have successfully fulfilled all the requirements of the naval authorities.—*The Engineer.*

HYDROPLANE STATION FOR THE FORTH.—A new department is to be established by the English Admiralty on the north shore of the Firth of Forth immediately to the east of the Forth Bridge and in close proximity to the heavy battery at Carlingnose. This new department is to be a base for hydroplanes, which will in all likelihood work in conjunction with the fleet in the way of effecting scouting operations. After much search up and down the coast the government authorities have decided that the spot selected is the finest in every way. It is ideal for hydroplane testing in respect that there is a long stretch of flat foreshore composed of yellow sand, and there is ample room to operate such machines without interrupting or being interrupted by shipping. Moreover, the place, which was a favorite picnic resort for Dunfermline and other holidaymakers and which is to be vacated by the present tenant within six months, obviously lends itself to

the centralization of government departments, for besides being overlooked by the fort at Carlingnose, which is to become the artillery headquarters for Scotland instead of the Leith Fort, it is not more than two miles from Rosyth and little more than four from Crombie.—*Page's Weekly.*

London cables of September 12 state that on account of the recent casualties to aviators of the British Army Flying Corps, four lieutenants having been killed within a week, the War Office has suspended the use of monoplanes in the service. British Army aviators consider that biplanes are safer and more stable than monoplanes. Machines of the latter type have been used, however, because they are speedier.—*Army and Navy Journal.*

MISCELLANEOUS.

NAVAL STRATEGY IN THE BALKAN WAR.—The navies of the Balkan powers may possibly not play an unimportant part in the war now in progress. The Turks have about 110,000 soldiers actually mobilized in Asia Minor between Smyrna and Scutari, and of course this force is constantly augmented by the reserves. It is easy to see then that Turkey must be able to transport these soldiers from Asia Minor to Europe. The shortest distance is that between Scutari and Constantinople, crossing the Bosphorus or the Dardanelles at Gallipoli. The defence of these points has been weakened owing to the withdrawal therefrom of many heavy guns for the defence of Adrianople. The Turks must therefore be able to transport by sea directly from Smyrna to Salonica, which is directly connected by rail to all important parts of Turkey, the major portion of its Asiatic soldiery. Being masters of the Aegean Sea they can do this. Peace with Italy has left their fleet free to take the sea. Thus we see that command of the Aegean is a military necessity for the Turks, and likewise it becomes so for the Greeks, because reinforcement of the Turkish Army must be prevented at all costs.

The truth of the adage "all depends on the command of the sea," is likely to again be demonstrated, particularly as the Balkans are now so far in the lead ashore that the Turks must be defeated unless they can get troops from Asia Minor.

The Turkish fleet ought now to find the principal Greek force and destroy it.

Similarly the Greek Admiral Kondourioti ought to keep his fleet close to the shores of Asia Minor to prevent all movement of the Turkish convoys with his destroyers placed as scouts, and to sink unconvoyed transports. By making use of the various islands in the Aegean Sea, the Greek fleet should be able to do much damage to the Turkish convoys without exposing themselves greatly. This is an ideal place for operations of the large Greek submarine *Delphin* to do much damage at little risk, save the navigational ones, to the convoys.—*Le Yacht.*

Of the facilities for safe anchorage and hasty repairs, which are so important to small navies, the following summary may be taken as covering the whole of the available resources. Otia Bay, which in 1904 was subjected to some examination by British naval experts, is said to form a good destroyer base, being capable of egress and approach in the dark. The Greeks will probably use this. The Island of Zanti has a coaling station, with a mole in the harbor, which enables war craft to quickly replenish their stock of fuel alongside it. The Gulfs of Patras and Corinth are marked as affording good and sheltered anchorage and a base for supplies, whilst the Corinth Canal, connecting the Gulf of Corinth with the Bay of Athens, is now an important feature of the scene of operations. It is passable by small cruisers. The Greeks have several dockyards, namely, one at Poros Island, south of Athens Bay, another at Salamis; they also have a large floating dock some 100 yards by 20 yards, so it will be seen that there is ample scope for an intrepid and determined Greek commander to carry on

buccaneering operations in the west. Further east, the Turkish authorities hold a stronger position, the Dardanelles and the Bosphorus being practically unassailable by reason of the dominating guns of the Dardanelles. These give Turkey the command of the Black Sea and the Sea of Marmora, from which they can land their forces at will.—*United Service Gazette.*

Turkish gunboats on Lake Scutari have done something to hinder the Montenegrin advance by bombarding their lines, but work of that sort cannot have any measurable effect on the run of the campaign. Should the war spread, the Black Sea might conceivably witness an advantageous exercise of Turkish sea power by threatening Bulgaria or Roumania at various points, and thus preventing the whole of the military forces of those nations being massed for fighting on the land frontiers. The influence of the naval factor would naturally be considerably greater if Greece should join the fray; but, on the whole, there is a decided tendency in this country to exaggerate the naval possibilities of the war. History shows that in conflicts between nations with coincident frontiers sea power always plays a decidedly minor part, and it is certainly improbable that the rule will be broken by the Balkan States.—*Naval and Military Record.*

Some brief notes have been given in the preceding pages of the Turkish and Grecian Navies in view of the present probable interest in them. They are the "principal" naval powers engaged; of the others Servia, has no sea frontiers, nor does she appear to possess any craft for the patrol of the Danube. Montenegro—the monarchy with a population of an average London suburb, which has put the match to the powder barrel—is the possibly proud possessor of a single vessel, a Royal yacht named *Zmidy*, launched in 1899, displacing 140 tons, and armed with two 3-pounders. Bulgaria and Roumania both possess a number of war vessels of the smaller types, but the only seagoing vessels owned by either is the Roumanian cruiser *Elizabetha*, launched at Elswick a quarter of a century ago. She displaces 1325 tons, and is armed with four 6-inch and a number of smaller guns. This state also possesses a number of river craft, including four efficient monitors of 581 tons displacement built in Austria in 1907. The names are *Joan Bratiano, Lascar Catargi, Lahovary,* and *Michael Cogalniceenu,* and they are armed each with three 4.7-inch guns in an equal number of turrets, and with two howitzers of the same caliber, while their speed is 14 knots. There are also three older and smaller gunboats, a despatch vessel of 130 tons, launched fifty years ago, and a couple of yachts.

Bulgaria has devoted more attention to torpedo craft. Three 98-ton torpedo-boats, the *Chrabri, Smeli,* and *Bistri,* were launched at Varna in 1907, their armament consisting of three 3-pounders and three torpedo-tubes, and their speed being 26 knots. There are also three smaller but newer torpedo-boats, a 715-ton torpedo-gunboat, the *Nadjezda,* launched at Bordeaux in 1898 and armed with two 4-inch and five smaller guns; and also two armored gunboats for service on the Danube. It will be seen that neither of these states would be able to do much at sea, and the vessels on the Danube have no opportunity of damaging Turkish property.

THE ENGLISH FLEET MANEUVERS OF 1912.

THE ENGLISH FLEET MANEUVERS OF 1912.—The Red fleet consisted of the battleships *Neptune,* flying the flag of Admiral Sir G. Callaghan, commander-in-chief of the home fleets; the *Collingwood,* flying the flag of Vice-Admiral Sir S. Colville; *St. Vincent,* flying the flag of Rear-Admiral C. E. Madden; *Bellerophon, Dreadnought, Temeraire, Superb,* and *Vanguard,* of the first battle squadron; the *Gloucester* and *Liverpool,* attached cruisers; the cruiser *Leviathan,* flying the flag of Rear-Admiral E. Bradford, and the *Cumberland, Cornwall, Donegal, Berwick,* and *Essex,* of the training squadron, and the *Hampshire* and *Suffolk,* of the Mediterranean cruiser squadron, the seventh (Devonport) destroyer flotilla and the eighth (Portsmouth) submarine flotilla, with their attendant vessels.

Admiral Sir W. May, umpire-in-chief during the maneuvers, hoisted his flag on the cruiser *Euryalus* at Devonport. Captain W. Fisher, assistant umpire, also embarked in the *Euryalus.—Army and Navy Gazette.*

The Red fleet, which had for its objectives that of attempting an invasion on Blue territory and of waging a war on its commerce, sailed from Nore, Dover, and Harwich at 4 a. m. on July 13 and timed itself so as to be able to land troops at ten that evening at Scarborough. The cruisers steamed at head of column, the destroyers having been detached along the coast to attack the Blue destroyers, and all was going well when about nine that evening the fleet ran into a thick fog bank, so thick that a ship was invisible from her next in column. Speed was reduced, and the Red fleet stopped. The *Victorious* and the *Majestic* collided and the former was compelled to retire from the maneuvers.

In the meantime the Blue * fleet, twice the strength of the Red and under the command of Prince Louis of Battenburg on the *Thunderer*, was coaling at the Firth of Forth, the second squadron going to sea on Saturday the 13th at eight in the evening, and the third squadron sailed a little later. The flotillas of the opponents had several engagements on Saturday night and Sunday.

Blue was uncertain whether the enemy would make a dash for the Atlantic, and from his bases at South Queensferry, Cromarty, Lamlash, and Oban, had to "feel" for the opposing fleet. The vessels on the East coast were accordingly sent cruising south, while the west coast division patrolled the Atlantic side, interrogating merchant vessels as they passed for information. Red, however, at first concentrated his force in the North Sea, and remained undiscovered from the start of operations on Saturday (13th) until Sunday (14th). The attacking fleet then lay off Filey, the battle squadron in compact lines with cruisers, scouts, and torpedo craft scouring the seas to ascertain if the Blue defenders were on the scent. The unexpected happened in the shape of a fog, and, feeling the coast to be dangerous and a surprise attack possible, the landing plans were postponed for a time and the Reds steered northwards, the cruisers spread out as a screen to the remainder of the fleet.

On Monday the Red fleet had reached the North Sea near the Orkneys, having succeeded in evading the scouts of the Blue fleet which had turned south and reached Kinnaird Head, where the remainder of the battle fleet was assembled. The cruisers of the Blue fleet found the approaching enemy, and Red, closing in his cruisers in battle formation, accepted the challenge to engage. The afternoon saw the cruiser action in full progress, and in the result Red claimed the advantage, three cruisers managing to dash through unscathed and reach the Atlantic trade routes. Fog again closed the encounter, and under its cover Red again escaped, not to be sighted again until Thursday.

In this action the Red had its cruisers *Cornwall, Donegal, Cumberland,* and *Berwick* put out of action, and later on the *Achilles* and *Cochrane* were captured.

On Tuesday the 16th the Red fleet found itself free from contact with the Blue, its battleships intact and in the North Sea. As an attack on the Atlantic side appeared to have no chance, the Red fleet stopped and held a counsel. At six Wednesday evening, they got underway, the flotillas in the van, the cruisers next and lastly the battleships; an invasion on the east coast was to be attempted.

The Blue fleet kept the sea, not detaching a cruiser to keep in touch with the Red fleet then steering northward. She was trying to come in contact with the enemy, was sending some of its ships to revictual, *i. e.*, those that had not been able to fill with coal at Firth of Forth. She stopped at sea to rest the engineer force, and later held some maneuvers. The nights of Tuesday and Wednesday brought no incident.

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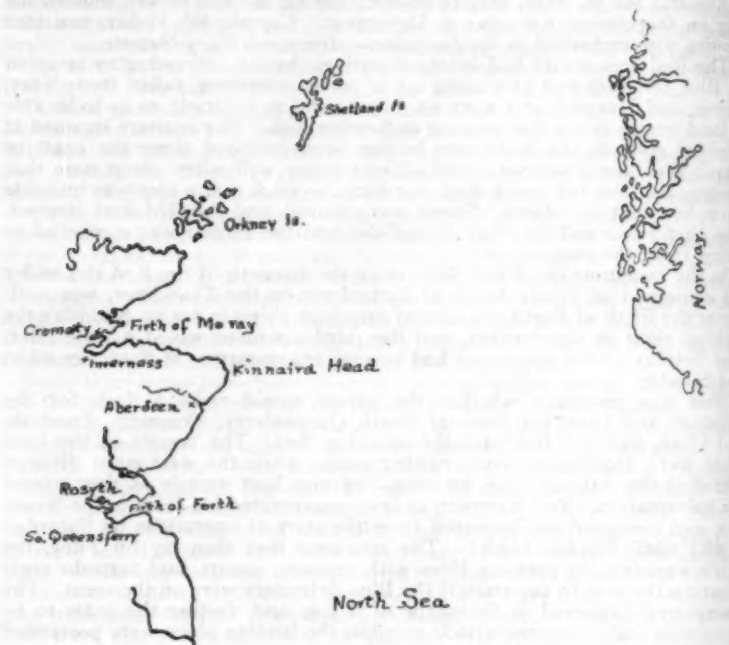
* See page 1135 of PROCEEDINGS No. 143.



ENGLISH MANEUVERS, 1912.

Scale: Rosyth to Dover by sea = 390 miles.

Lamlash and Oban are on S. W. coast of Scotland about latitude of Firth of Forth.

But on the morning of Thursday some very interesting news reached the Blue fleet, which then sailed south at full speed, the *Lion* and *Indefatigable* well in the lead, in pursuit of the Red then heading to the north to make a landing.

The Red fleet profiting by the night, and having steamed at full speed, daybreak on Thursday found its flotillas at Yorkshire without having met any opposition. The cruisers were sent to the north to watch the Blue and the battleships reached Filey where they simulated the landing of a force beginning at 6.30. After landing its troops the Red fleet was to escape by the northwest of England so as to damage commerce. It is reported by some that three, by others that four, battle-cruisers did succeed in this. The landing was accomplished in six hours at a rate of 7000 men per hour from the 14 transports. The operation was successful, there being no news of the Blue fleet until 10. At 11 the Red cruisers signalled the Blue fleet was arriving, the *Lion* being in the lead by a large amount, the invasion was discovered and the weak Red fleet had to leave.

So seeing that the landing could not be proceeded with without interruption, and recognizing that the approaching force was superior, Admiral Callaghan resolved to retire. The Blues went in hot pursuit, headed by the speedy *Lion* and *Indefatigable*, but the Red commander tried a desperate move—and it succeeded. While his main fleet was scurrying off at top speed the old seventh battle squadron—comparatively slow and heavy *Majestics*—were detached from the line and formed up in line of battle to hold the pursuing squadrons in check. The screening squadron was sacrificed, for at the end of the sharp and fierce conflict every vessel was ruled out of action, but the main Red fleet was saved, and when Blue resumed the pursuit, after having cleared away the obstruction, Admiral Callaghan was quite out of reach and beyond danger. Blue's total losses were two armored cruisers and a couple of dozen smaller craft as the result of the engagement; but Red, despite the loss of six battleships and two armored cruisers, besides several torpedo craft and submarines, was still at large and in touch with his base when, two hours after the battle, the order came from the Admiralty that the operations were at an end.

Thus the Red was the victor. It succeeded in the landing, it had been able to send three cruisers to the north to injure the Blue's commerce. One might say it had fulfilled its double mission. But the Red was obliged to take refuge in its own ports after having lost four battle-cruisers, six battleships, 28,000 men and 14 transports; while the conquered Blue had remained immune and was master of the situation.

It is a new demonstration that certain operations, invasion, commercial war, are not possible save to the one who is mistress of the sea, and a battle is necessary to obtain the mastery of the sea.—Compiled from *Moniteur de la Flotte, Royal United Service Institution, Army and Navy Gazette*, etc.

THE ISHERWOOD SYSTEM OF SHIP CONSTRUCTION.—On page 780 of No. 142, mention was made that our collier *Orion* was constructed on the Isherwood system of horizontal framing. This method has not proved the success that its promoters led the shipbuilding trade to believe. As originally planned it saved 8 per cent in structural material. The requirements of the increased scantling found necessary to remedy the structural weakness reduced this saving to nothing. The torsional stresses are so great that one ship built on this system was actually twisted twelve to eighteen inches, and intermediate transverse frames had to be placed. *Shipping*, Illustrated, states that Scott Russell in 1834 originated this system, the first vessels built under it were in 1847 and the 50's. In 1872 J. E. Scott patented a similar construction. Mr. Isherwood later patented the same. It is stated by good authorities that were the classification societies to allow the liberal treatment accorded to the Isherwood system to apply to transversely framed ships, that the latter would be the lighter for the same strength. The cost of labor with transverse framed vessels is less than with the longitudinal or Isherwood framed vessels.

LIFE SAVING APPARATUS AND SALVAGE APPLIANCES FOR SUBMARINE BOATS.—The total loss of all or in most cases of nearly all of the crews in numerous accidents to submarines demands measures for life saving and salvage for the submarines.

The following list shows the casualties among submarines:

1. *Lutin*, French, at Bizerta in 1904, cause technical failure.
2. *Delphin*, Russian, at St. Petersburg in 1904, cause faulty management.
3. *A 1*, English at Nab Lightship in 1904, cause collision when submerged.
4. *Farfadet*, French, at Bizerta in 1905, cause faulty construction and management.
5. *A 8*, English, at Plymouth in 1905, cause bad management.
6. *Kambala*, Russian, in Black Sea in 1909, cause bad management.
7. *C 11*, English, at the mouth of the Humber, cause collision when cruising on surface.
8. *Pluviose*, French, off Cherbourg in 1910, cause collision when submerged.
9. *No. 6*, Japan, 1910, cause, technical failure.
10. *A 3*, English, 1912, cause, collision when submerged.
11. *Vendemaire*, French, 1912, cause, collision when submerged.
12. *B 2*, English, October 5, 1912, collision with S. S. *Amerika* in the early gray dawn.

In the above causes the casualties due to bad management, faulty construction, and technical failures may be overcome readily, but there will always be danger of collisions when submerged. Four of the above casualties were due to collisions when submerged, with two collisions when on the surface.

Life saving apparatus are such means that may be used by the crew of the submarine, while salvage appliances must be used externally to the submarine.

Life saving apparatus are of three different classes:

1. Appliances for saving the lives of all hands.
2. Those that provide for saving the lives of some of the crew.
3. Those that provide for saving the life of individuals.

Pumps and compressed air are appliances of the first kind. Compressed air in steel flasks can be used to expel the water leaked into compartments and thus a submarine having sprung a leak may reach the surface by decreasing its displacement. Detachable safety weights may be detached to decrease the displacement and in like manner permit the submarine to rise to the surface. The French submarine *Loutre* on March, 1911, had such detachable weights that she used successfully. The sudden removal of the weights gave the submarine a sudden impulse to emerge to the surface.

Water-tight bulkheads and cross-bulkheads will insure a degree of safety, but they hamper access to different parts of the boat, and must be kept with water-tight doors closed before collision.

When a submerged submarine is cruising in a condition of equilibrium any sudden increase of weight in either end will cause the boat to assume an approximately perpendicular position—most unfavorable for the boat and crew. In this position the German submarine, *U 3*, was found in the accident January, 1911. The water was shallow.

There are other subordinate appliances for saving all the crew; the best of which is the renewal of the air in the boat so that it may be possible for the crew to remain longer submerged. The supply of oxygen to replace that consumed.

The appliances to provide for saving some of the crew are still of problematical value. It is proposed to have buoyant attachments to the submarine which can be reached by means of water-tight openings by some of the crew who could get out through the door and by detaching the buoyant attachment rise to the surface with it.

This has an advantage of permitting escape from a sunken submarine, but it has many drawbacks. In the first place they would require a number of such detachable buoyant vessels to be attached to the exterior hull of the

submarines and such attachments would interfere seriously with the displacement of the submarine, her speed and ability to dive, and it would then be impossible to have such attachments at places, where (in case of need to abandon a sunken boat) they would be available, since the sunken boat is not apt to lie horizontally on the bottom when sunk, but on its side or inclined.

The French submarine, *Gustave Zédé II*, has a detachable conning-tower. The merits of this fitting are not as yet known.

The third class for saving the life of individuals is common. The principle is to provide each of the crew with a sort of a diving suit. The Germans have adopted the Drager—diving saver. This consisted of a vest with airbag connected with a pair of hose attached as a gag to the mouth of the wearer. The appliance permits the wearer to remain submerged for one hour and upon reaching the surface the breathing apparatus may be easily removed. His arms are free and automobile goggles protect his eyes. This apparatus has been found to be partially satisfactory, but it requires practice to be able to use the diving saver, just as it does for those who are expert divers in diving suits. The protection given by this apparatus is only partial and special training such as is given in England in submarine models is requisite for efficient use of such apparatus.

Means for salvage of sunken submarines consist of lifting docks, wrecking cranes, wreckships, and wrecking lighters. A modern wrecking ship must be able to work under all conditions. She must raise a weight of from 400 to 1000 tons quickly in one hoist from a depth of 50 meters (164 feet). The wrecking vessel should be able to work in a moderate sea and against strong currents and also be able to go to the rescue of the sunken boat promptly, to raise it and transport to a dock. Besides the wrecking vessel should have all the latest equipment for salvage of submarines.

The lifting docks do not meet the first requirement to lift the weight in one hoist except in shallow water. In such a case the sunken boat may be raised to the surface and carried by the dock to shoal water and then lowered again to the bottom and finally raised clear. The use of the lifting dock is thus limited.

Wrecking lighters, built especially for wrecking submarines, must be towed and anchored with accuracy so that they may not be capsized especially with action of a strong current. The need of tugs and other limitations make the docking ship the most desirable.

The German submarine *U 3* was sunk so that her bow pointed up. In this position 28 men were in the bow torpedo room, whence they escaped to the surface. The wrecking vessel could not handle the submarine in such a position and the wrecking crane was used.

The German submarine docking ship *Vulcan*, with double hull and space for lifting a submarine in between the hulls and then docking her in the ship itself, is most satisfactory.

Submarines must have fittings to facilitate salvage. In the first place they should be fitted so that the tackle of a wrecking ship or crane can be attached either by a diver or with special arrangements. The telephone buoy is a most valuable equipment. This can be sent up to the surface from the conning-tower and being connected within the submarine will enable the commander to phone information in regard to the condition in which the sunken submarine may be in special danger.

Many of these features have been adopted in the different navies, though none seem to have as yet provided for all conditions and progress in different navies is very different.

The measures adopted and in use in some navies are doubted by others and progress is being made by all in rendering the management of submarines more reliable and the submerged cruising less dangerous.

The twelve casualties grouped at the head of this article show that in recent accidents submerged collision is the chief danger and efforts to reduce that risk must be chiefly studied and practised.—*Ueberall*, by W. H. B.

BOOK NOTICES.

"Forecasting Weather," by W. N. Shaw, F. R. S., Sc. D., Director of the Meteorological Office, London. Published by the D. Van Nostrand Company. Price $3.50 net.

The work of this distinguished author presents a valuable and interesting volume to the public. As stated in the introduction, he has endeavored to bring the facts of the daily weather into relation with the physical processes of the laboratory, to acquaint the meteorologist with the physicist to the advantage of both.

After a short but useful and necessary chapter on units, the author explains and illustrates the construction and use of synoptic charts, and the method of forecasting by their means. Empirical rules, framed in the light of long experience have been quoted, and the relation of wind velocity to the distribution of pressure, a subject of great importance, has been dealt with. Having set out the position arrived at by empirical generalization, an examination has been made of the physical processes which are developed in the phenomena of weather, and illustrations of the connection between the observed phenomena and the processes upon which they depend are given.

Particularly interesting are the author's chapters upon special departments of the work of forecasting, such as gales, storm warnings, anticyclonic weather, land and sea fogs, night frosts, colliery warnings and forecasts for aeronauts. One chapter is devoted to statistical methods for long-period and seasonal forecasts. The book concludes with a chapter on the practical utility of weather forecasts.

The numerous illustrations are a valuable feature, though the details of the charts have suffered from the process of reduction, the scale of representation being rather minute. As stated by the author, however, no alternative exists except reproduction at full size, which would render the book too cumbersome. These charts are essential to an intelligent perusal of the book, and the defect mentioned above detracts nothing from their usefulness.

The book deals with the methods of forecasting employed by the English Government, and naturally the examples and illustrations analyzed pertain to the British Isles and Western Europe. But the principles studied may be applied to any locality. It is interesting to note that forecasting on a scientific basis was begun in Great Britain about fifty years ago by a naval officer, Admiral Fitz Roy. The rules that had become established, after about twenty-five years experience, were formulated and published by another experienced seaman, the Hon. Ralph Abercromby. The forecasting of the weather and general investigation thereof has and will always be of paramount importance to seamen, in spite of the wonderful advances daily in the construction of ships. Any light thrown upon these subjects is therefore of value to seafaring men. The author rests not here, however,

for valuable hints to agriculturalists, owners or superintendents of collieries and aeronauts are included. Suggestion as to methods of rendering more accurate the forecasts for special localities are given, which, if noted, would probably reduce the percentage of local forecasts which are apparently at variance with the daily reports sent out by our own Weather Bureau. Quite frequently the principle of the general inference is correct, but the caprices of the weather make the local application something quite different from what might fairly have been expected by the forecaster. A well-informed local inhabitant, in possession of the general inferences sent out by the Weather Bureau, could probably give a local forecast more applicable to the particular district than the general official forecast which is all that can reasonably be expected of the Weather Bureau. The reader becomes convinced of the facts set forth above and acquires much more useful information bearing upon this subject, and is well repaid for the time spent thereon. The book should find a place in all libraries.

C. P. SNYDER, Lieut.-Commander, U. S. Navy.

"U. S. Marine Corps Score Book," by Captain William C. Harllee, U. S. Marine Corps. Published by International Printing Company, 236 Chestnut Street, Philadelphia, Pa. 15 cents postpaid.

This book is the summing up of Captain Harllee's wide experience in the instruction of both inexperienced men and of candidates for rifle team.

When on duty at Marine Corps Headquarters Captain Harllee formulated a plan to create an awakening in interest in rifle practice, and under General Elliott put this plan in effect. Its principal features were to give an extended course of instruction to about a hundred selected men and distribute these men to all the stations of the marine corps, and to form camps of instruction with skilful instructors and to gather these men from all accessible stations and put them through a systematic and progressive course designed to instruct them with the greatest economy of time.

When these plans were put into effect the next step was to provide a manual of instruction which would enable men to be prepared at their stations instead of after their arrival at ranges and thus effect a greater economy of time and a larger output of trained riflemen.

His book furnishes the result of his experience along these lines as well as his experience as captain of the Marine Corps Rifle Team for three years.

The text is clear and simple so that men may use it to instruct themselves in case they do not have the benefit of instructors.

The outline for instructors is so presented that unskilled instructors can follow it easily. The first part of the book is for the instruction of inexperienced men and contains no confusing matter not essential for beginners. Then follows the score book proper, then some handy and easily learned rules in regard to the sights, then some notes on external conditions and these are handled with a decision which does not characterize most writers on this subject, then follow notes on methods of instruction and miscellaneous matter.

The book has been adopted as a text for the examination for promotion of marine officers.

It ought to find favor with the navy, naval militiamen and others whose problem, like that of the marines, is to get effective methods with the greatest economy of time.

"Diplomatic Negotiations of American Naval Officers, 1778-1883," by Charles Oscar Paullin. Published by the Johns Hopkins Press, Baltimore, Md., 363 pages. Price $2.00.

To many students of naval history the periods between wars are little known, yet these years of peace are fully as interesting as the wars, and represent much labor and many big achievements on the part of our officers that we are justly proud of. These lectures by Mr. Paullin fill in the gaps between wars and teach us what officers have accomplished as diplomats. Mr. Paullin is one of the leading authorities on American naval history and is well known without introduction to all readers of the Institute. The book is excellently made up, printed in clear legible type.

The easy style of the author makes the reading and study of this work agreeable and very attractive.

Peculiarly interesting are the negotiations with the Barbary States, Korea, the islands of the Pacific, and Africa. RALPH EARLE.

MINUTES OF THE ANNUAL MEETING.

The annual meeting of the United States Naval Institute was held October 11, 1912, at 8 p. m., at the Officers' Mess, U. S. Naval Academy.

Captain J. H. Gibbons, U. S. Navy, presided, there being twenty-two members present.

The first business being the election of officers, the Chairman appointed as tellers: Lieut.-Commander R. C. Bulmer, U. S. Navy, Lieutenant M. Milne, U. S. Navy, and Mr. C. L. Leiper, Instructor, U. S. Naval Academy.

The Chairman announced that the tellers reported as follows:

	Votes.
For President: Rear-Admiral Bradley A. Fiske, U. S. Navy	323
For Board of Control:	
Commander Geo. W. Logan, U. S. Navy	235
Commander H. F. Bryan, U. S. Navy	136
Commander A. B. Hoff, U. S. Navy	131
Commander L. M. Nulton, U. S. Navy	204
Lieut.-Commander N. L. Jones, U. S. Navy	171
Lieutenant E. J. King, U. S. Navy	127
For Secretary and Treasurer:	
Lieut.-Commander Ralph Earle, U. S. Navy	306

Other votes scattered.

The above named officers were then declared elected.

The Secretary and Treasurer reported as follows:

The past year the Institute suffered an irreparable loss in the death on February 23, 1912, of Professor Philip R. Alger, U. S. Navy, who had been its successful secretary and treasurer since February 24, 1903.

The Board of Control in recognition and appreciation of co-members of the Institute for Professor Alger's devotion to the work with which he had been so long and notably associated, requested Rear Admiral Knight to write the article which appeared in the issue of the PROCEEDINGS for March, 1912. Copies of this article together with a suitable letter were transmitted to Mrs.

Alger. Professor Alger's salary was continued to the end of February.

Lieut.-Commander W. B. Wells, U. S. Navy, acted as secretary and treasurer from August, 1911, until November 1911. Professor Alger after November, 1911, was able on account of his health to only attend the meetings of the Board of Control on December 7, 1911, and January 18, 1912.

The present secretary and treasurer was elected by the Board of Control on February 27, 1912.

A firm of public accountants audited the books of the Institute in March, finding them absolutely correct, a real and deserved testimony to the ability and faithfulness of the clerk, Mr. Conroy.

The action taken at the last annual meeting relative to nominating officers for election resulted in the polling of a heavy vote, the highest vote for any member of the Board of Control last year being 72, whereas this year it was 235. Last year the secretary and treasurer received sufficient blank proxies to enable him to re-elect himself, and to select his own Board of Control. This year there are but 37 blank proxies.

The membership of the Institute is now:

Regular	795
Life	129
Associate	142
Honorary	3
Total	1069

During the year 11 members resigned, 15 died, and 109 new members were admitted, making a total increase of 83, against 21 for the preceding twelve months. This is an increase, but still not as great a one as it appears, considering that in 1907 there were 979 members in all. In other words, in five years there has been a net increase of only 90 members.

The quality of material in the PROCEEDINGS cannot be very materially improved if more interest than is evidenced by this record is not taken by the service at large in it. The secretary is, and has been endeavoring to reach every officer in the service, and urge them to become members. The membership from the staff and Marine Corps is not as large as it should be.

Members besides getting shipmates to join are urged to obtain associate members from their friends in civil life who are interested in the service.

The strictures placed by the Navy Department early in March, 1912, upon the material permitted to be published in the PROCEEDINGS, materially reduced the available professional topics and deterred many officers from writing. This action showed itself immediately to the secretary in the fewer articles submitted. On the other hand this procedure is a distinct advantage, because no officer need worry in the slightest on what he submits for publication, as it will not be printed save with the full authority of the Department.

In the endeavor to get mature and authoritative papers on professional subjects reference to the War College was made, and through the co-operation of its president, much valuable matter has been obtained for the PROCEEDINGS. Suggestions for topics of articles suitable or desired by the service are always much welcomed by the secretary.

FINANCIAL STATEMENT FOR THE YEAR ENDING OCTOBER 1, 1912.

Briefly stated, the Institute's financial resources consist of:

a Bonds having a market value of	$42,604.50
(Of this amount $6,753.14 is the Reserve Fund.)	
b Savings deposits to amount of	9,019.62
c A check deposit in Farmers' National Bank of	9,927.52
These result in a total of	$61,551.64
Against which there are liabilities of	5,654.83
Therefore leaving the present actual resources of the Institute	$55,896.81
Without counting the bills receivable which now amount to	7,425.02
Or if they are added the resources become	$63,321.83

Approximately the cost of publishing the PROCEEDINGS per year is $11,000, for which amount there is received from the interest on investments, the dues, the subscriptions and the advertisements, $6000.

The sale of extra publications thus has to make up the deficit. It does this, and leaves a balance for investment.

The excess over expenditures and liabilities for the past year has been $8,431.99. In considering this it must be remembered that this figure for the calendar year of 1911 was but $150, the difference being mostly in the sales of books printed in 1911.

It is to be hoped, as Professor Alger stated in his report of 1907, that at some not so distant date, we may reach the point where the income from our investments will make us independent of any other receipts than the annual dues of members. To accomplish this, our income from investments must be increased from the present $2235 per annum to $7200 per annum. This is being done as funds become available by their investment under the direction of the Board of Control in bonds that are legal trustee security.

The following were then elected life and associate members:

LIFE.

Mr. C. O. Paullin.

ASSOCIATE.

Lieutenant Kemol, Turkish Navy.
Lieutenant L. T. Cutter, U. S. Revenue Cutter Service.
Mr. K. C. Woodward.
Mr. Burnell Poole.
Mr. K. M. Lundburg.
Mr. Elmer A. Sperry.
Mr. Wm. E. Clark.
Lieutenant James Pine, U. S. Revenue Cutter Service.
Lieutenant F. J. Sexton, U. S. Revenue Cutter Service.
Major Wilmot E. Ellis, C. A. C., U. S. Army.
Mr. H. E. Kaighn.
Lieutenant M. Nousret, Turkish Navy.
Lieutenant John F. McGourty, U. S. Revenue Cutter Service.

The following resolution proposed by Lieutenant W. R. Van Auken, U. S. Navy, was adopted:

Resolved, That it is the sense of this meeting that the Institute should allow the members of the Board of Control five dollars for each meeting of the same as may be attended by them, and also that they be furnished one copy of each book, then in print, that is published by the Institute that they may desire.

The following resolution introduced by Commander L. M. Nulton, U. S. Navy, was adopted:

Resolved, That it be the sense of this meeting that the remainder of the salary due the late Professor Alger for the time for which he was elected be paid to his widow, and that the Secretary and Treasurer forward the same with a suitable letter expressing the recognition and appreciation by his co-members of the Institute of his work for, his interest in, and his success with the affairs of the Institute and its publication, the PROCEEDINGS.

Commander A. B. Hoff, U. S. Navy, suggested a change in method of assigning titles for prize essays for the Institute each year. After a discussion of the suggestions by several members, the following resolution was adopted:

Resolved, That it is the sense of this meeting that the Board of Control each year obtain from the summer conference of the Naval War College, the Commander-in-Chiefs of the Atlantic, Pacific and Asiatic fleets, and the Superintendent of the Naval Academy, suggestions as to the most suitable subjects on which the prize essays should be written each year.

There being no further business before the meeting, it adjourned at 8.55 p. m.

RALPH EARLE,
Lieut.-Commander, U. S. Navy,
Secretary and Treasurer.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. E. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CULIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884.

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SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1913.

A prize of two hundred dollars, with a gold medal, and a life-membership in the Institute, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1913. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. If, in the opinion of the Board of Control, the best essay presented is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention" or such other distinction as the Board may decide.

5. In case one or more essays receive "Honorable Mention," the writer of the first of them in order of merit will receive seventy-five dollars and a life-membership in the Institute.

6. Any essay not having received honorable mention may be published also, at the discretion of the Board of Control, but only with the consent of the author.

7. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either typewritten or copied in a clear and legible hand.

9. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

RALPH EARLE,
Lieut.-Commander, U. S. N., Secretary and Treasurer.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now completes its thirty-ninth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary, and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fees to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing."

The Proceedings are published quarterly and anyone may subscribe for them. The annual subscription is $3.00; single copies, 75 cents. Annual dues for members and associate members, $2.00. Fee for life membership, $30.00.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.

SPECIAL NOTICE TO MEMBERS.

It is believed that the interest and scope of the essays and articles published in the PROCEEDINGS can be continued and improved, and you are cordially invited to assist in this work.

Should any topic occur to you on which you believe an essay or article should be written, or on which you would like to read one, send such topic to the Secretary at once. These topics will be published in the PROCEEDINGS as suggested, desirable ones for essays and articles, and thus many essays and articles on a wide range of subjects may be obtained.

By direction of the Board of Control.

RALPH EARLE,
Lieut.-Commander, U. S. Navy,
Secretary and Treasurer.

NOTICE TO MEMBERS.

More members, both regular and associate, are much desired. Any increase in membership invariably means a larger number of papers and essays submitted, and consequently an improvement in the PROCEEDINGS.

You are requested to send or give the attached slip to some one eligible for membership, urging him to join.

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There is no initiation fee.

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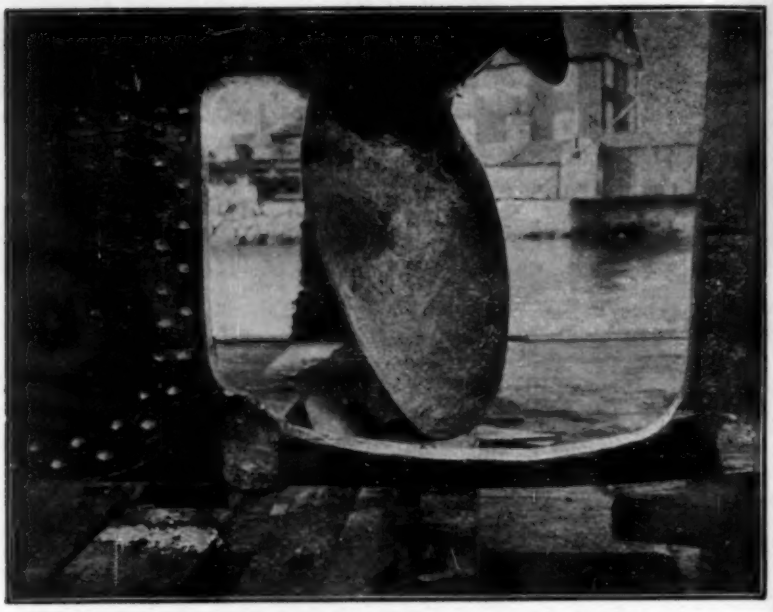

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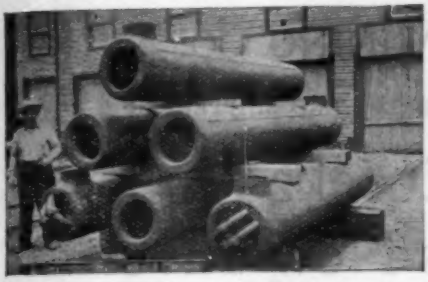

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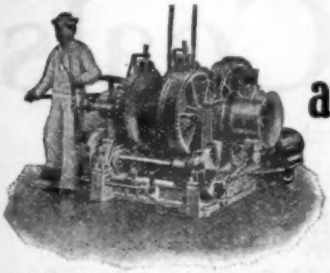

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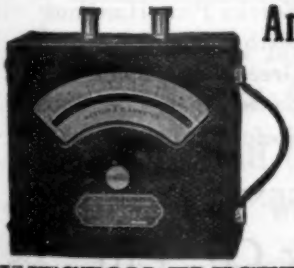

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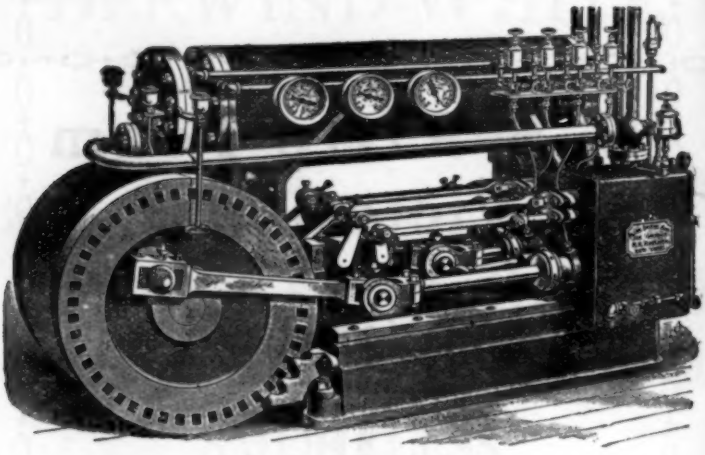

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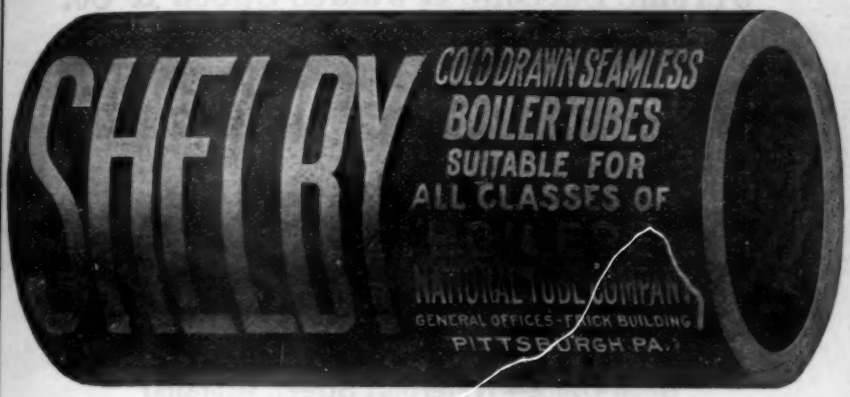

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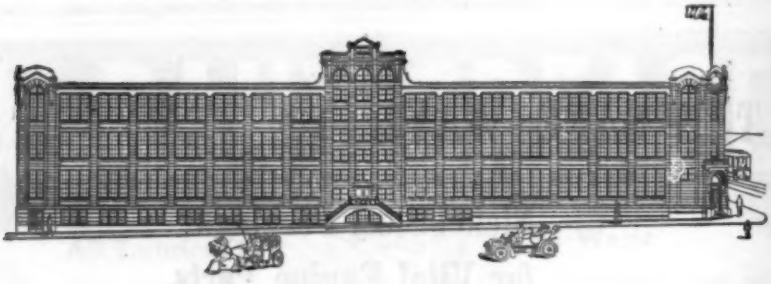

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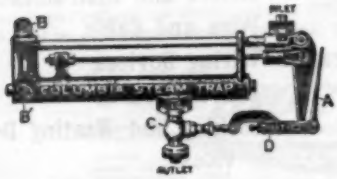

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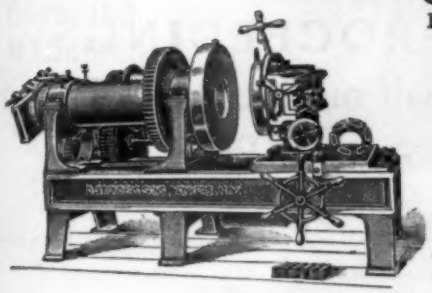

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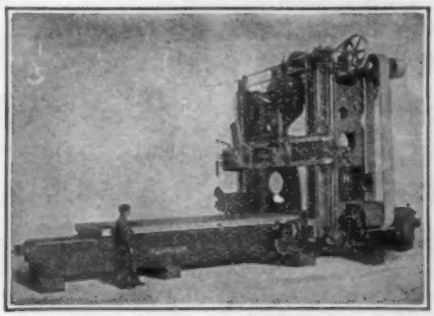

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